

VOLUNTARY FORESTRY BEST MANAGEMENT PRACTICES FOR WATER QUALITY PROTECTION IN ARKANSAS

RESULTS OF THE 2007-2008 BMP IMPLEMENTATION SURVEY



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John T. Shannon, State Forester
Director of the
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EXECUTIVE SUMMARY

The Arkansas Forestry Commission (AFC) surveyed the implementation of voluntary forestry Best Management Practices (BMPs) on 274 sites totaling 24,230 acres. These sites were randomly selected from a pool of 3,339 candidate sites representing final harvest forest operations that occurred statewide between March 2007 and July 2008.

Overall BMP implementation was 86 percent on sites monitored. In general, implementation was highest on public and forest industry sites and lowest on private non-industrial sites. Federal tracts averaged 99 percent, state sites averaged 93 percent, industrial sites averaged 89 percent, and private non-industrial forest landowners (PNIFLOs) averaged 81 percent. Of the nine Arkansas Forestry Commission Districts, District 1 scored highest, while Districts 4 and 9 were significantly lower.

Implementation rate by four regions:

- Delta - 88 percent
- Ozark – 87 percent
- Ouachita – 86 percent
- Gulf Coastal Plain or Southwest– 86 percent

Implementation rate by BMP category:

- Harvesting – 92 percent
- Regeneration – 87 percent
- Roads – 82 percent
- Streamside Management Zones – 80 percent

Implementation rate by Arkansas Forestry Commission Districts:

- District 1 - 91 percent
- District 2 - 88 percent
- District 3 - 88 percent
- District 4 - 80 percent
- District 5 - 87 percent
- District 6 - 91 percent
- District 7 - 88 percent
- District 8 - 87 percent
- District 9 - 77 percent

Improvements needed on all ownership classes during the survey were:

- Water-bars on skid trails, fire-lines, and inactive roads;
- Seeding and mulching where needed to stabilize soil;
- Temporary crossing structure removed and bank stabilization;
- Mechanical site preparation in ephemeral stream channels.

TABLE OF CONTENTS

Background and Objectives	6
Survey Methods	7
Site Selection	7
Site Characteristics.....	7
Monitoring Personnel.....	8
Monitoring Questionnaire.....	8
Significant Risks	8
Statistical Analysis of Data	8
Overall BMP Implementation	9
BMP Survey Results	10
Roads.....	10
Harvesting.....	12
Regeneration	13
Streamside Management Zones	14
Landowner Implementation	16
PNIFLO Questionnaire	17
Implementation by Physiographic Region.....	19
Historical versus Current Survey Implementation.....	21
Conclusion	22
Appendix.....	23

BACKGROUND AND OBJECTIVES

The 1972 Clean Water Act required states to establish a program to encourage implementation of Best Management Practices (BMPs) to control non-point sources of pollution. Reauthorization of this Act in 1987 additionally required states to develop methods for determining and measuring effectiveness of these voluntary BMP guidelines.

The AFC is responsible for the state's Forestry BMP program and has relied on a voluntary program of implementation based on training and education of forest landowners and users. Initial forestry BMP guidelines were developed in the early 1970s. Forest erosion data obtained through soil loss monitoring, and information gathered by investigating forestland complaints were the basis of the first education and training efforts.

In 1996, Arkansas adopted BMP implementation survey procedures developed by the Southern Group of State Foresters titled *Silviculture Best Management Practices Implementation Monitoring, a Framework for State Forestry Agencies*. This document provided a framework for monitoring BMP implementation that is statistically sound, objective, technically feasible, and consistent with BMP program efforts in all 13 southern states.



Objectives of the implementation monitoring program include:

1. Measuring, documenting, and reporting the statewide extent of forestry BMP implementation.
2. Evaluating the general effectiveness of BMPs as applied operationally in the field.
3. Determining the need and direction of forest BMP education and outreach programs.

This report documents findings of the sixth BMP implementation survey, which was performed from March 2007 until July 2008. The AFC completed and published its first implementation report in 1998, the second in 1999, the third in 2001, the fourth in 2004, and the fifth in 2007.



SURVEY METHODS

The sixth survey was conducted according to the publication “*Silviculture Best Management Practices Implementation Monitoring, a Framework for State Forest Agencies*” adopted in 1996.

SITE SELECTION

Without knowledge of the location and occurrence of a large pool final harvest operations existing at one point in time, statistically accurate sampling would not be possible.

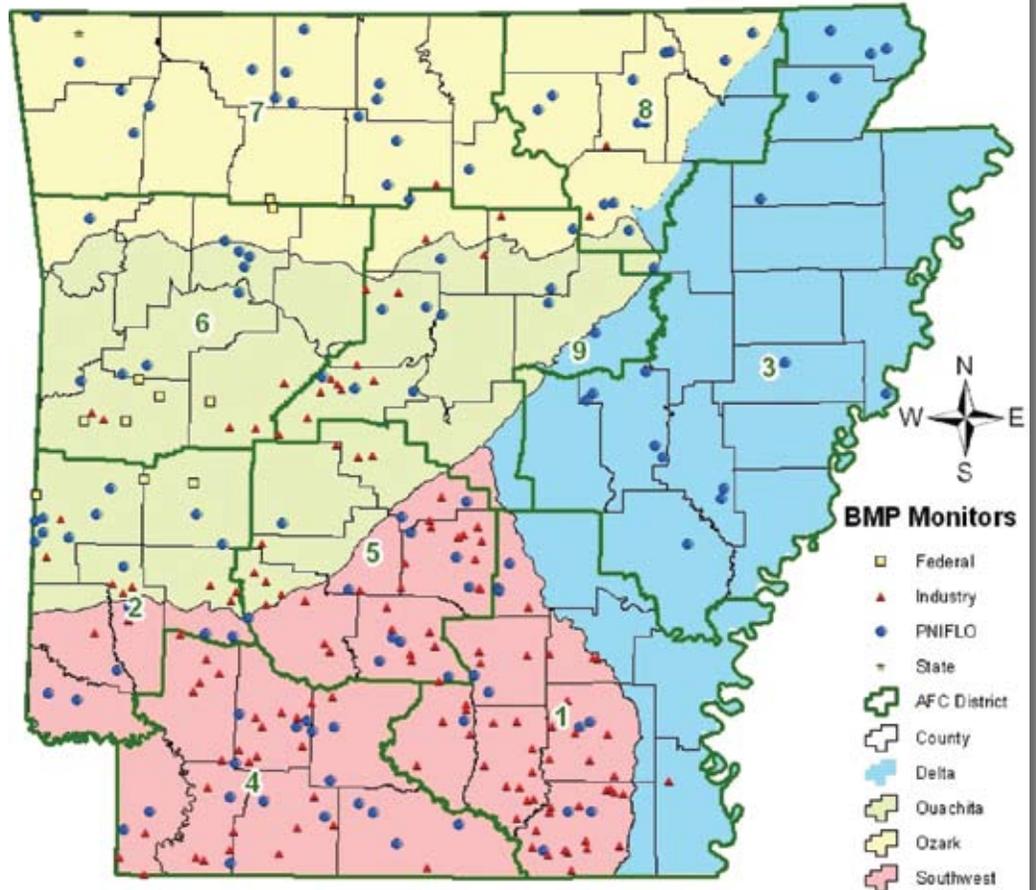
Site selections were made using a Digital Aerial Sketchmap System (DASM) in conjunction with an AFC aircraft, to record (log) harvest sites. A total of 3,339 harvested sites were located, and a total of 274 tracts were randomly selected for monitoring. Distribution of selected sites was based on timber severance tax records (see Appendix, page 23). Statistical analysis from previous surveys indicated this sample size would yield results within a 95 percent confidence level.

AFC personnel received landowner information sheets to complete for each candidate site. Sites selected were only those representing typical silvicultural operations less than one year old, and not land conversions to other uses. Final harvest tracts were preferred, as they reflected maximum potential for erosion.

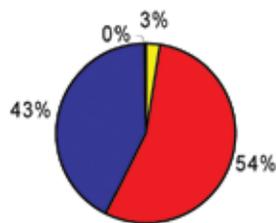
SITE CHARACTERISTICS

PNIFLOs owned 123 of the sites surveyed, forest in-

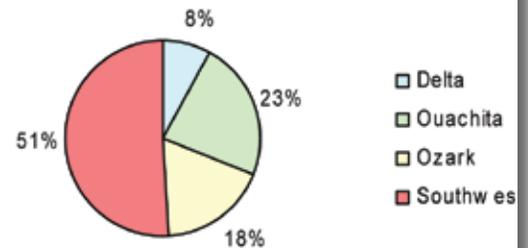
Monitoring Site Distribution



Acres Surveyed by Ownership Class



Acres Surveyed by Region



dustry owned 138 of the sites, the U.S. Forest Service owned 11 of the sites, and the State owned 2 of the sites monitored.

The survey recognized four regions of the state: Ouachita, Ozark, Delta, and Gulf Coastal Plain or Southwest. Fifty one percent of the survey sites were located in the Southwest region. The Ouachita region contained 23 percent, the Ozark region had 18 percent, and the Delta Region had 8 percent of the sites.

Two hundred sixteen tracts surveyed were final harvest cuts, 51 were thinned, 6 tracts were seed tree har-

vest, and 1 was a salvage cut for a total of 274. The BMP implementation rate on final harvest tracts was 86 percent, on thinned tracts 87 percent, on salvage cuts 84 percent, and on seed tree harvests 96 percent.

Professional foresters were involved in silvicultural treatments on all industrial and federal tracts surveyed. Professional foresters were involved in 32 of 123 PNI-FLO tracts surveyed.

MONITORING PERSONNEL

The BMP Forester and the BMP Specialist completed all site evaluations. The use of two trained, experienced personnel in performing the survey provided consistency of the data acquisition and control of the survey process.

MONITORING QUESTIONNAIRE

The monitoring questionnaire was revised to reflect new BMP guidelines adopted in March, 2002. The questionnaire contains 67 questions based on four BMP categories: Streamside Management Zones, Roads, Harvesting, and Regeneration. Questions were created from the BMP guideline book, and were referenced with applicable section and sub-section numbers. Each question was worded so that a positive answer was recorded with a "Yes", while a departure from BMP recommendations received a "No" response. Answers for questions that did not apply were indicated by "NA".

A final score, expressed as a percent of positive answers versus total answers, was given to each tract. Compiling data from all tracts allowed analysis of statewide BMP implementation. Analysis of BMP implementation for tract ownership, state physiographic region, and AFC District was also conducted.

SIGNIFICANT RISK

Each question also included a determination of significant risk. A significant risk is a situation, or set of conditions, that has resulted in, or very likely will, result in the significant and measurable degradation of water quality, and can be remedied or otherwise mitigated.

Fourteen significant risks were documented on 11



tracts during this survey. Eight were found in the harvesting category, 5 were found in the category of SMZs, and 1 in the category of roads. In the harvesting category, 7 of the 8 significant risks were related to stream crossings, while the other was related to a skid trail. The 5 SMZ significant risks were related to absence of a SMZ (1), disturbance within the SMZ (2), and significant logging debris left in the stream channel (2). Absence of water bars on an inactive road were the cause of the significant risk in the roads category.

STATISTICAL ANALYSIS OF DATA

As with any survey, samples were taken to estimate the true value. Accuracy of the estimate was affected by the sample size and the variability within that sample. In this BMP implementation survey, each result is accompanied by a margin of error. Statistical analysis of the samples indicate the true value will be within this margin of error 95 percent of the time.

To allow comparison of the results, one has to know if the differences are real or a result of sampling error. Statistical significance is reported to allow comparison of the reported results. Analysis of variance and multiple t-tests was performed on the survey data. A Least Significant Difference (LSD) comparison was run on all comparable data. Statistically significant differences were those which occurred at a 5 percent probability level. That is, with 95 percent confidence, one can claim differences are significant and not a result of sampling error.

OVERALL BMP IMPLEMENTATION

Data was grouped with in four major BMP categories: Roads, Harvesting, Regeneration, and Streamside Management Zones (SMZs). Overall implementation percent and percent by major categories are presented below.

Table 1. Overall BMP Implementation Summary

Category	Number of Tracts	Implementation Percent	Margin of Error	Statistical Significance*
Roads	172	81.65	2.89	c
Harvesting	274	92.46	1.36	a
Regeneration	95	87.12	4.86	b
Streamside Management Zone	179	80.43	3.72	c
Overall Implementation Rate	274	86.15	1.60	

* Implementation percents having a different significance letter are significantly different than other categories at the 5 percent probability level.

Harvesting had a significantly higher BMP implementation rate than the BMP categories of Roads, Regeneration, and Streamside Management Zones (SMZs). This higher rate indicates forest operators have good knowledge of the recommended BMPs and implemented them during the operation of timber felling, skidding, and location of landings.

Regeneration averaged a score of 87 percent, which is significantly lower than the Harvesting category. The Roads and SMZ category scored an 82 and 80 percent respectively, which are both significantly lower than all other categories. The recommended BMPs for the categories of Roads and Regeneration generally require specialized equipment, and as a result, cost more to implement than those recommended in the Harvesting category. The higher cost might explain the lower scores for these categories. The costs associated with the recommended BMPs pertaining to SMZs also might explain lower scores.

In general, for the Roads and Regeneration categories, implementation of BMP close-out procedures needed the most improvement. Observations during the survey noted lack of water-bar installations where needed. Water-bars are a BMP soil stabilization practice implemented in close-out operations for inactive roads, skid-trails, and firelines. Correct water-bar installation and spacing requires technical skills, plus the use of specialized equipment such as a bulldozer. All harvest operations utilize skidders, while not many employ a bulldozer.

For the SMZ category, mechanical site preparation disrupting an ephemeral stream channel caused the most concern. These smaller channels when disturbed are direct conduits for sediment during rainfall events. Incorrect identification of ephemeral versus non-ephemeral streams continues to be an issue with the implementation of SMZs.



BMP SURVEY RESULTS

ROADS

The Road category has historically scored low in comparison to other categories. The high cost of construction has often resulted in a lack of Road BMP implementation on forestlands, especially for PNIFLOs.

Proper road construction is a result of good planning and is usually done prior to the start of the logging operation. If BMPs are not implemented properly, roads have the greatest potential for introducing sediment into Arkansas's streams.

As in previous surveys, the highest implementation of forest road erosion control measures were observed on federally owned tracts, 99 percent (Table 21, page 23). The lowest implementation of recommended erosion control measures was found on PNIFLOs, 74 percent (Table 19, page 23).

In this survey, all questions in the Road category scored above the 80th percentile range with the exception of those questions associated with lack of soil stabiliza-

tion, and implementation of water diversion structures. Generally, more attention was paid to BMP implementation prior to and during harvest. Usually, BMP implementation was poor for close-out operations.

Areas of most concern: (See questions: 3.36a, 3.27, 3.42, 3.48, 3.71, 3.83, and 13.10 page 10 and 11).

- Lack of seeding and mulching where needed to prevent excessive erosion;
- Lack of rolling dips and wing ditches on permanent roads;
- Lack of water-bars on inactive roads.

Failure to implement water-bars, rolling dips, and wing ditches can be associated with the lack of proper equipment, or the lack of expertise to construct the structures where needed. Interviews with loggers indicated the failure to implement water-bars occasionally was a result of the landowner's request for accessibility after the harvest.

Table 2. Forest road survey results

Road BMPs	Number of Tracts	Implementation Percent	Sig. Risk
3.12. Roads located to avoid or minimize stream crossings?	140	99.29	--
3.13. Streams were crossed at right angles?	82	98.78	--
3.14. Where topography permitted, roads were located along the contour and along the crest of long ridges?	159	99.37	--
3.25. Side cast or fill material placed above the ordinary high water mark of any stream, except where necessary to stabilize stream crossings?	50	98.00	--
3.27. Seeding and mulching were employed in a timely manner to reduce erosion?	79	35.44	--
3.36a. Water turnouts, broad-based dips or rolling dips were installed before a stream crossing to direct road runoff water into undisturbed areas of the SMZ?	76	72.37	--
3.36b. Roads, with the exception of stream crossings, located outside the SMZ?	108	99.07	--
3.42. Erodible areas, where natural vegetation is not sufficient to stabilize the soil, revegetated or stabilized?	96	48.96	--
3.48. Where needed, roadbed reshaped and all drainage systems opened when all forestry activities were completed?	129	79.84	--
3.52. On roads, temporary crossing structures removed and stream banks stabilized and restored after use?	17	88.24	--
3.53. Permanent stream crossings used bridges, culverts, shelf rock fords, geoweb, concrete slabs or other materials?	70	97.14	--



Table 2 continued.

Road BMPs	Number of Tracts	Implementation Percent	Sig. Risk
3.54. Low water ford banks are stable and stream bottoms are hard?	38	97.37	--
3.55. Except at stream crossings, equipment kept out of streambeds?	102	99.02	--
3.56. Are concrete slabs installed and functioning properly?	13	100	--
3.61. Broad-based dips present where needed?	53	92.45	--
12.10. Broad-based dips properly constructed	51	98.04	--
3.71. Rolling dips present where needed?	91	69.23	--
12.20. Rolling dips properly constructed?	64	90.63	--
3.83. Wing ditches present when needed?	120	65.83	--
12.30. Wing ditches constructed and functioning properly?	79	92.41	--
3.85. Wing ditches not feeding directly into adjacent drainage, gullies, or channels?	72	90.28	--
3.90. Culverts present where needed?	74	85.14	--
3.92. Culverts installed properly?	64	98.44	--
12.40. Appropriate culvert size used?	64	93.75	--
3.97. Where needed, aggregate or other suitable material used on approaches to fords, bridges, and culvert crossings?	53	81.13	--
13.10. Water bars present as specified on inactive roads?	88	55.68	1
4.13. Water bars installed and functioning properly?	50	82.00	--
4.14. Sufficient distance left between outflow discharge of waterbar and stream to allow "sediment fallout"?	48	87.50	--
Forest Roads Implementation Rate	172	81.65	1

HARVESTING

The category of Harvesting scored significantly higher than the other three categories. Recommended BMPs for basic timber removal were usually implemented well. All landowner groups scored highly on the recommended BMPs. (Tables 19, 20, and 21, page 23).

High scores in the Harvesting category can be attributed to the large number of loggers trained by the Arkansas Timber Producers Association (ATPA) as required by the Sustainable Forestry Initiative Program (SFI).

Areas of most concern: (See questions 5.17 and 5.47 page 12.)

- Lack of water-bars on closed skid trails;
- Lack of removal of temporary fill material from stream beds;
- Stabilization of stream banks on closed skid trails.

As in the Road category, better attention is paid to the implementation of BMPs associated with active logging sites. More attention is needed to install the proper BMPs after the logging job is complete.

Table 3. Harvesting Survey Results

Harvesting BMPs	Number of Tracts	Implementation Percent	Sig. Risk
5.17. Are water bars constructed on skid trails per specifications in Table 13.1, Figure 13.1, page 46?	91	29.67	1
5.23. Are the size and number of log landings minimized?	273	100	--
5.24. Are landings located away from SMZs on firm level ground?	192	95.83	--
5.25. Are landings located on dry sites so natural drainage disperses water onto the forest floor but not into a stream?	268	97.76	--
5.41. When skidding, where contours followed to the greatest extent possible?	169	97.04	--
5.43. Skid trails on slopes have occasional breaks in grade or logging slash that disperses water?	182	88.46	--
5.44. At skid trail crossings, soil not used as a temporary fill material when water was in the stream?	78	84.62	2
5.47. On skid trails temporary fill material removed from stream beds and stream banks stabilized?	75	49.33	5
5.48. No skid trails in stream channels?	178	96.63	--
5.52. Was skid trail construction minimized at grades greater than 30 percent?	17	100	--
5.53. On grades greater than 30 percent, were frequent rolling dips installed?	12	91.67	--
5.62. Litter, such as oil cans, grease containers, crankcase oil filters, old tires, and used fluids absent from site?	272	98.53	--
Harvesting Implementation Rate	274	92.46	8

REGENERATION

The category of Regeneration consists of reforestation and site preparation activities. Site preparation normally occurs on final harvest tracts, and involves operations that prepare the ground for the reforestation. Standard surveyed site preparation operations consisted of chemical application of herbicides to remove competing vegetation, mechanical ground clearing of vegetation, a combination of both these methods, or, on some tracts, simply burning the timber residue following harvest. To restrict these fires to the site, control the rate of burning, and protect SMZs from intensive heat, fire lanes are installed, usually by bulldozer.

The average BMP implementation score for the category of Regeneration was 87 percent. All questions that scored below the 80th percentile range are associated with site preparation burning.

Areas of most concern: (See questions: 10.12b and 10.34 page 13).

- Fire lanes not constructed by hand in the SMZ;
- Lack of water-bars on fire lanes after close out.

The potential for erosion on fire lanes is high and approximate to forest roads, since they consist of exposed mineral soil. Fire lanes are recommended to follow contours, but are often located on, or parallel, to property boundary lines. These fire lanes have high potential for erosion since they are plowed without regard to contours. In some cases, the fire lanes may have steep, continuous grades.

As in the categories of Roads and Harvesting, water-bars are not being installed on fire lanes. One difference in this category is that proper equipment is available, since bulldozers are used to construct fire lanes and are necessary to construct proper water-bars. Training and education efforts will help create awareness of the problems associated with fire lanes.

Table 4. Regeneration Survey Results

Regeneration BMPs	Number of Tracts	Implementation Percent	Sig. Risk
6.15. Has intensive site preparation been avoided on soils the NRCS has identified as highly erodible?	44	93.18	--
6.16. Existing water control devices (i.e. culverts, wing ditches) not damaged?	50	100	--
6.17. Heavy equipment operations avoided in wet soil conditions?	70	87.14	--
6.18. Did intensive site preparation follow the contours of the land?	65	89.23	--
7.11. Forest chemicals apparently excluded from SMZs?	52	96.15	--
8.11. Machine planting follows the contour of the land?	8	87.50	--
8.13. No evidence of machine planting equipment crossing or turning around in roads, road ditches and wing ditches?	7	85.71	--
10.12a. Fire lines installed parallel to streams and not plowed through the SMZ?	19	94.74	--
10.12b. Fire lines within the SMZ constructed by hand?	3	66.67	--
10.13. On final harvest cuts, when slopes of the site exceed 20 percent, individual fire strips do not exceed 300 feet in width between ignition and burnout?	0	--	--
10.34. On slopes exceeding 5 percent, and at approaches to streams and roads, were water bars installed in fire lines according to the BMP recommendations for skid trails?	27	59.26	--
Regeneration Implementation Rate	95	87.12	--

STREAMSIDE MANAGEMENT ZONES

One hundred and seventy-nine sites contained non-ephemeral streams (perennial or intermittent). The large number is consistent with past surveys and highlights the need for water quality protection in silviculture operations. Overall, 80 percent of the recommended BMPs were properly implemented in the SMZ category. The SMZ category implementation rate was significantly lower than the categories of harvesting and regeneration. Many individual questions scored below the 80 percentile.

Areas of most concern: (See questions: 2.11, 2.14b, 2.18, 2.23, 2.31, 2.41, 2.51, 6.12. page 14 and 15).

- Lack of proper SMZ width on slopes less than 7 percent;
- Spacing of trees left in the SMZ;
- Significant logging debris left in stream channel;
- Ephemeral stream channels disturbed by mechanical site preparation practices;
- Lack of proper SMZs for braided streams;
- Lack of SMZs for lakes and ponds;
- Removal of bank and overhanging trees;
- SMZ boundaries not defined for site preparation practices.

It is generally recognized that SMZs protect water quality. However, the high value of the wood products within these zones can lead to over-harvest. PNIFLOs

scored significantly lower than all other ownerships in implementing BMPs in the category of SMZs. However, to protect water quality, the BMP recommendation is to leave a minimum of 35 feet on both sides of the channel, a basal area of 50 square feet per acre, and trees left should be evenly spaced throughout the SMZ. The AFC recommends three widths of SMZs for non-ephemeral streams. These width classes vary by the slope adjacent to the stream, and are reflected in questions 2.11, 2.12, 2.13 in Table 5.

In contrast, the survey indicated the SMZ width on lesser slopes was slightly lower than on the steeper slopes. Observation of the steeper sites indicates SMZs regularly exceeded the minimum recommended widths of 80 feet due to being too steep for equipment to operate. Slopes of lesser degree were operable to the point all timber was accessible for those operators or land-owners inclined to over-harvest.

The lowest implementation rate (60th percentile) in the SMZ category was noted for the disruption of the ephemeral stream channel. An intact forest floor along ephemeral streams is recommended, however, unless the mechanical operator lifts the blade or plow of the equipment when crossing the channel of the stream, sedimentation in a non-ephemeral stream occurs when it rains. Logger BMP training is extensive, but site preparation operators are not specifically targeted for training.

Table 5. Streamside Management Zone Survey Results

Streamside Management Zone BMPs	Number of Tracts	Implementation Percent	Sig. Risk
2.11. Minimum SMZ width (35') present for SMZs bordered by land with less than 7 percent slope?	143	77.62	1
2.12. Minimum SMZ width (50') present for SMZs bordered by land with slopes 7-20 percent?	45	86.67	--
2.13. Minimum SMZ width (80') present for SMZs bordered by land with slopes > 20 percent?	6	83.33	--
2.14a. Basal area of residual trees in SMZ meet guidelines?	149	84.56	--
2.14b. Spacing of SMZ overstory trees meet guidelines?	147	76.87	--
2.16. SMZ trees removed in a manner that minimizes disturbance to the forest floor, exposure of mineral soil, or reduction of stream bank stability?	122	93.44	2
2.18. Absence of significant logging debris in stream channel?	172	77.33	2
2.19. Absence of toxic and hazardous materials such as fuels, lubricants, and solvents in SMZs?	173	99.42	--

Table 5 continued. Streamside Management Zone Survey Results

Streamside Management Zone BMPs	Number of Tracts	Implementation Percent	Sig. Risk
2.23. Mechanical site preparation did not disrupt the ephemeral stream channel?	53	60.38	--
2.31. SMZ provided between braided stream channels as well as the prescribed SMZ width adjacent to the most exterior channels?	14	78.57	--
2.41. Appropriate SMZ provided for lakes and ponds?	14	71.43	--
2.51. Trees growing directly on the bank or overhanging a water body were not cut?	149	75.17	--
2.52. Mineral soil not exposed by prescribed fire?	16	93.75	--
2.53. SMZ is free of log decks?	176	98.30	--
2.55. Cave entrance and sinkholes free of logging debris?	5	100	--
6.12. Boundaries of all SMZs defined where site preparation occurred?	87	78.16	--
Streamside Management Zone Implementation Rate	179	80.43	5

LANDOWNER IMPLEMENTATION

Landownership was grouped in four major categories: Industrial, Federal, State, and PNIFLO. Due to the land base and management styles, harvests on publicly owned lands are few compared to other ownership classes; because of the random sampling method, they have a smaller sample size than the other ownerships.

PNIFLO

Though implementation rates are the highest recorded, the PNIFLO score of 81 percent was significantly lower than other classes of forestland ownership. The implementation rate for industrial, state, and federal ownerships scored 89 percent or above. PNIFLOs owned 43 percent of the sites surveyed, and as a group, need the most improvement in how they implement recommended BMPs (Table 18, page 23). Increased emphasis is needed to reach PNIFLOs with the benefits of proper BMP implementation.

By primary category of BMPs, PNIFLO implementation rates for all BMP categories was lower than the other classes of forest ownership (Tables 19, 20, and 21 page 23). The Harvesting category, as was true for all classes of forest ownership, had the highest score (Table 1, page 9).

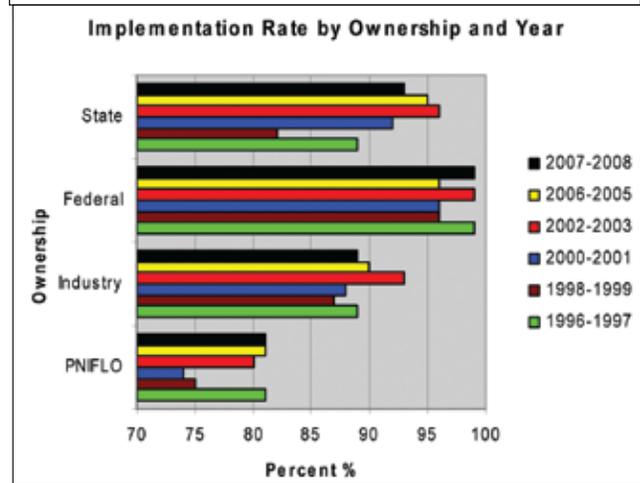
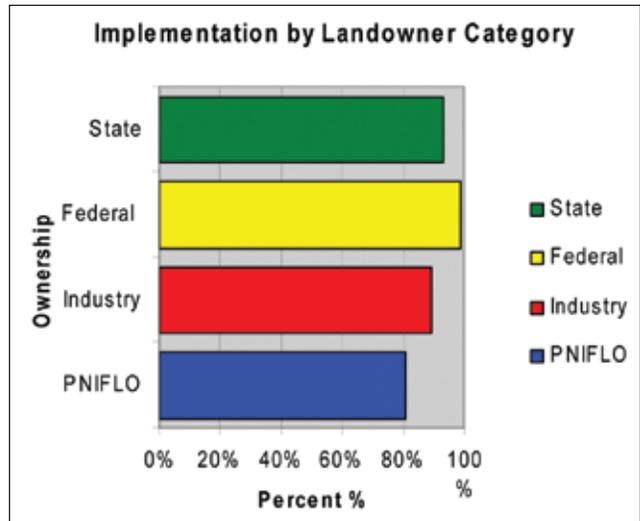
PNIFLO implementation rates were lowest (64 percent) for the category of Regeneration. The SMZ and roads categories both scored 74 percent (Table 19, page 23). Historically, the Road and SMZ category have needed the most improvement within the PNIFLO ownership class.

INDUSTRY

Industry has historically scored well overall (Table 25, page 24). Although significantly lower than federal ownership, industry scores remain close to state ownership score and significantly higher than PNIFLO scores (Table 18, page 23). Industry comprised 54 percent of the acreage monitored in the survey.

The Industrial BMP implementation rate was significantly higher for the primary BMP categories of Harvesting and Regeneration. Roads and SMZs both scored 85 percent, which is significantly lower (Table 20, page 23). Survey observations and discussions with industrial foresters indicate that lower SMZ implementation rates may be due to interpretation of ephemeral versus non-ephemeral streams.

A strong industry certification program has resulted in higher scores. Companies that are compliant with forest land certification standards require BMP training for loggers and therefore, should have a higher degree of BMP implementation.



FEDERAL

Federal lands surveyed for BMP implementation were located in the Ouachita and Ozark National Forests. Eleven Federal sites were surveyed; representing 3 percent of the acres surveyed.

Federal ownership has historically scored the highest overall. An overall score of 99 percent was significantly the highest of all ownership classes.

There was no significant difference between the primary BMP categories. Each category scored 99 percent or higher, except for regeneration which was not applicable to the sites monitored (Table 21, page 23).

STATE

Due to the random selection method and small number of harvests on state land, there were only two sites that were chosen to monitor. Two final harvests were monitored comprising 70 acres on state highway department land. Regeneration was not applicable to the sites monitored. There were no significant differences between the primary category scores, with all scoring 89 percent or higher.

PNIFLO QUESTIONNAIRE

In Arkansas's BMP surveys, PNIFLOs have consistently had lower implementation scores in comparison to other landowner categories. This landowner group owns approximately 60 percent of the forest land in Arkansas, and provides the same ratio of wood products produced annually in the state. In view of that fact, it is a priority that actions are taken to bring BMP

implementation rates for this group to the level of other forest land ownership classes.

In attempt to find answers and determine direction for future education efforts, PNIFLOs were polled about their BMP awareness during their forest operations. The effect that BMP awareness, or lack of it, has on BMP implementation rates on PNIFLO lands are revealed in the following tables:

Table 6. Question 1 - Was professional forestry assistance provided?

	Number	Acres	Implementation Percent	Margin of Error	Statistical Significance*
Yes	32	3,603	84.09	4.96	a
No	79	6,175	81.57	3.20	a

*Implementation percents having a different significance letter are significantly different at the 5 percent probability level.

In contrast with the previous survey, professional forestry assistance did not seem to significantly impact implementation rates. Data for professional assistance and BMP category in tables 7 and 8 were compared to each other. Therefore, letters of statistical significance for the two tables should be considered together.

Table 7. Implementation Rates For Landowners That Received Professional Assistance

	Number of Tracts	Acres	Implementation Percent	Margin of Error	Statistical Significance*
Roads	17	2,453	76.42	10.80	b
Harvesting	32	3,603	92.44	4.29	a
Regeneration	10	1,023	77.50	19.88	ab
SMZs	20	2,758	75.94	14.52	b

*Implementation percents having a different significance letter are significantly different at the 5 percent probability level.

Table 8. Implementation Rates For Landowners That Did Not Receive Professional Assistance

	Number of Tracts	Acres	Implementation Percent	Margin of Error	Statistical Significance*
Roads	37	3,929	75.04	5.94	b
Harvesting	79	6,175	88.31	2.96	a
Regeneration	3	87	25.00	50.00	c
SMZs	50	4,972	74.99	6.01	b

*Implementation percents having a different significance letter are significantly different at the 5 percent probability level.

The comparison of the regeneration category was significantly different for both answers. This indicates that professional assistance is affecting implementation rates for the recommended BMPs for the regeneration category. All other category comparisons yielded no interaction with implementation rates and assistance received, however compliance was slightly higher for those who received assistance.

Table 9. Question 2 - Was the landowner familiar with BMP guidelines?

	Number	Acres	Implementation Percent	Margin of Error	Statistical Significance*
Yes	33	2,909	84.17	5.50	a
No	78	6,869	81.51	3.04	a

*Implementation percents having a different significance letter are significantly different at the 5 percent probability level.

Table 9 indicates that there was a lack of familiarity of the recommended BMPs among PNIFLOs surveyed. There was no significant difference in implementation rate between landowners who stated they had knowledge of BMPs and those who did not.



Table 10. Question 3 - Did the landowner require a written sales contract for the timber harvest?

	Number	Acres	Implementation Percent	Margin of Error	Statistical Significance*
Yes	67	6,360	82.04	3.47	a
No	44	3,418	82.69	4.28	a

*Implementation percents having a different significance letter are significantly different at the 5 percent probability level.

Table 10 reveals the majority of PNIFLOs required a written sales contract for their forest operations. These landowners scored statistically the same as those landowners who did not require a contract.

Table 11. Question 4 - If a written contract, were BMPs required?

	Number	Acres	Implementation Percent	Margin of Error	Statistical Significance*
Yes	29	2,419	85.41	5.83	a
No	73	6,639	80.29	3.24	a

*Implementation percents having a different significance letter are significantly different at the 5 percent probability level.

Table 11 shows no significant difference among landowners who required BMPs in their contract and those who did not. However, scores were slightly higher for those who required BMPs.

Table 12. Question 5 - Was the landowner a member of a forest organization?

	Number	Acres	Implementation Percent	Margin of Error	Statistical Significance*
Yes	16	1,402	84.97	6.45	a
No	95	8,376	81.85	2.88	a

*Implementation percents having a different significance letter are significantly different at the 5 percent probability level.

Table 12 shows the majority of the landowners surveyed were not members of a forest organization. There was no significant difference in implementation rate among those who were and were not a member of an organization.

IMPLEMENTATION BY PHYSIOGRAPHIC REGION

Implementation rates within four major Arkansas land divisions were compared for this survey.

Table 13. Implementation Rate by Region

Region	Number of Sites	Acres	Implementation Percent	Margin of Error	Statistical Significance*
Ozark	40	4,301	86.66	3.49	a
Ouachita	70	5,673	86.38	3.21	a
Southwest	146	12,399	85.63	2.32	a
Delta	18	1,857	88.36	5.71	a

*Implementation percents having a different significance letter are significantly different at the 5 percent probability level.

The Delta region scored the highest overall BMP implementation rate, however was not significantly different from the other regions.

All regions decreased in implementation rates from the previous survey, except for the Southwest region, which remained at 86 percent.

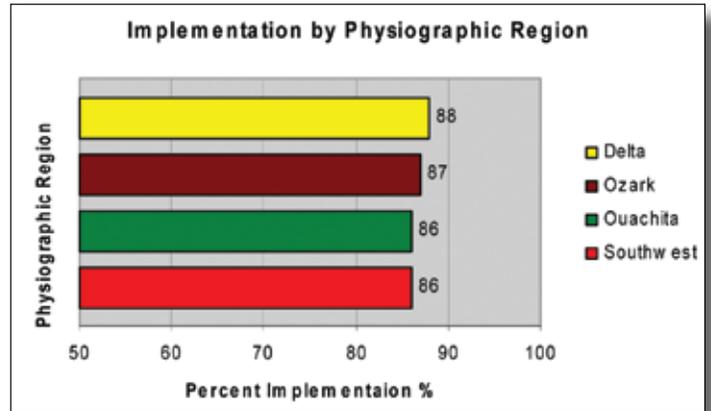


Table 14. Ozark Region

Category	Number of Tracts	Acres	Implementation Percent	Margin of Error	Statistical Significance*
Roads	25	3,062	78.41	7.92	b
Harvesting	40	4,301	92.91	2.91	a
Regeneration	6	590	61.11	40.06	c
SMZs	25	3,669	86.66	4.33	ab

*Implementation percents having a different significance letter are significantly different at the 5 percent probability level.

In the Ozark Region, the regeneration category scored significantly different for the region. The steep slopes of the rugged Ozark Region require the ultimate in BMP implementation, expertise, and expense. If BMP recommendations are properly applied in this mountainous terrain, high numbers of various soil stabilization techniques, such as rolling dips, turnouts, water-bars, and artificial revegetation practices are a necessity.

Table 15. Ouachita Region

Category	Number of Tracts	Acres	Implementation Percent	Margin of Error	Statistical Significance*
Roads	54	5,035	87.91	3.68	a
Harvesting	70	5,673	90.56	3.17	a
Regeneration	26	2,498	90.82	8.99	a
SMZs	45	3,882	76.16	8.89	b

*Implementation percents having a different significance letter are significantly different at the 5 percent probability level.

The Ouachita region, like the Ozark region, is mountainous, though the terrain is not as steep or rugged as the Ozarks. Pine is the predominant timber type, and as a result, there is a much larger forest industry influence. The SMZ category scored significantly lower than all other categories for the region.

The coastal plain dominates the Southwest Region and the terrain is much less rugged.

Table 16. Southwest Region

Category	Number of Tracts	Acres	Implementation Percent	Margin of Error	Statistical Significance*
Roads	87	8,660	78.99	4.52	b
Harvesting	146	12,399	93.28	1.78	a
Regeneration	63	6,625	88.07	4.85	a
SMZs	98	8,774	80.00	5.14	b

**Implementation percents having a different significance letter are significantly different at the 5 percent probability level.*

The Southwest Region led the state in timber production and in number of tracts surveyed. As a result, BMP implementation rates, by BMP category, parallel the statewide rates (Table 1, page 9).

The Delta region scored well in harvesting and SMZs; however the roads category dropped from previous surveys. Regeneration activities were not applicable to the 18 tracts monitored in the region.

Table 17. Delta Region

Category	Number of Tracts	Acres	Implementation Percent	Margin of Error	Statistical Significance*
Roads	6	840	77.23	12.80	b
Harvesting	18	1,857	92.21	5.24	a
Regeneration	0	--	--	--	--
SMZs	11	1,479	87.59	10.56	ab

**Implementation percents having a different significance letter are significantly different at the 5 percent probability level.*

HISTORICAL VS. CURRENT BMP IMPLEMENTATION SCORES

This sixth implementation survey averaged 86 percent implementation, two percent lower than the previous survey. The decrease could be due to an extremely large amount of rainfall and the rare flood events observed during the monitoring period. The frequency and volume of flow placed on the existing mechanisms such as culverts, water-bars, wing ditches, etc., could have impacted answers to the survey.

An overall BMP implementation rate in the higher 80th percentile held over recent surveys can be attributed to two factors. First and foremost, the increased use of forestry BMPs in Arkansas forest operations. The second is the new survey form that has been developed to better represent the new BMP guidelines. More BMP recommendations are addressed in the new survey form, some of which are common and easily implemented.

There is no doubt that a high BMP implementation rate is occurring due to the stringent guidelines adopted by forest companies under their respective forest certification programs.

BMP implementation rates for the PNIFLO ownership category have consistently lagged behind the implemen-



tation rates of other ownerships (Table 25, page 24).

LOGGER TRAINING

BMP Logger Training, conducted by the Arkansas Timber Producers Association (ATPA), has been ongoing since 1993. Currently, more than 10,000 individuals are on record as having received BMP training.

In cooperation with ATPA the AFC trained a total of 1,348 loggers and foresters in 43 BMP programs during the 2005-08 federal grant period that helped fund this survey.

CONCLUSION

Statewide forest BMP implementation rates have remained in the upper 80th percentile for the past three surveys. There was an increase in the proportion of PNIFLO tracts randomly selected to monitor during this survey. This could be a factor in the 2 percent drop in the statewide average from the last survey. Implementation in all landowner categories showed some PNIFLO improvement, while Industry decreased slightly. Federal and State remained in the 90th percentile.

The advent of forest industry certification programs such as the Sustainable Forestry Initiative (SFI) of the American Forest and Paper Association (AF&PA) has had a positive impact on implementation of BMPs. Statistically, forest industry lands scored significantly lower than Federal lands, but continue to score well above the PNIFLO ownership.

PNIFLOs continue to score significantly lower in implementation than the other landowner groups. Since PNIFLOs own approximately 60 percent of Arkansas woodlands and wood products, it is a priority that state and industrial education efforts be centered on this group.

The training that has been emphasized for loggers need now be directed toward the PNIFLO base of Arkansas.

Four major physiographic regions of Arkansas were checked for implementation: Ozark, Ouachita, Delta, and Coastal Plain or Southwest. All regions scored between 86 and 88 percent, with no significant differences in the regions. The Southwest had the lowest overall implementation rate in the last survey, but due to the decrease in scores of the other regions was not significantly lower for this survey. Since it has the highest volume harvested and the majority of the acres in operation, careful attention should be paid to the region.

Arkansas Forestry Commission Districts scored highest in District 1 and significantly lower in District 9. Recognizing the need for improvement in the lower



scoring Districts will help focus AFC training needs.

Overall, BMP training needs more emphasis on close out procedures. BMP implementation for the Harvesting category is consistently high in all regions and for all landowners. Implementation of the recommended BMPs within the Roads category decreased during this survey. BMPs implemented after the harvest is completed, need to improve. Implementation of water-bars, whether for roads, skid trails, or fire lanes, needs improvement. The use of seeding and mulching for soil stabilization continues to have low implementation. All training and education efforts need to emphasize these BMPs. The AFC is adapting its training to target these changing deficiencies and low scoring areas using the information from the implementation surveys.

APPENDIX

Tables	23
AFC District Offices	24
Wood Harvest and Distribution of Implementation Survey Sites.....	25

TABLES

Table 18. Implementation by Landowner Category

Ownership	Number of Tracts	Acres	Implementation Percent	Margin of Error	Statistical Significance*
PNIFLO	123	10,324	81.42	2.64	c
Industry	138	13,199	89.24	1.82	b
Federal	11	637	99.10	1.32	a
State	2	70	92.72	7.66	a

Table 19. PNIFLO Implementation by BMP Category

Category	Number of Tracts	Acres	Implementation Percent	Margin of Error	Statistical Significance*
Roads	62	6,837	73.92	5.50	b
Harvesting	123	10,324	89.32	2.34	a
Regeneration	16	1,180	63.54	20.18	b
SMZs	79	8,076	73.52	5.71	b

Table 20. Industrial Implementation by BMP Category

Category	Number of Tracts	Acres	Implementation Percent	Margin of Error	Statistical Significance*
Roads	98	10,123	84.65	3.25	b
Harvesting	138	13,199	94.63	1.57	a
Regeneration	79	8,207	91.90	3.37	a
SMZs	93	9,334	84.83	4.92	b

Table 21. Federal Implementation by BMP Category

Category	Number of Tracts	Acres	Implementation Percent	Margin of Error	Statistical Significance*
Roads	10	567	98.68	1.87	a
Harvesting	11	637	100	--	a
Regeneration	0	--	--	--	--
SMZs	6	364	100	--	a

Table 22. State Implementation by BMP Category

Category	Number of Tracts	Acres	Implementation Percent	Margin of Error	Statistical Significance*
Roads	2	70	88.89	22.22	a
Harvesting	2	70	93.75	12.50	a
Regeneration	--	--	--	--	--
SMZs	1	30	100	--	a

Table 23. AFC District Implementation by BMP Category

District	Number of Tracts	Acres	Implementation Percent	Margin of Error	Statistical Significance*
District 1	57	4,562	90.73	2.60	a
District 2	29	3,062	87.75	4.66	a
District 3	18	1,892	87.90	5.52	a
District 4	48	4,275	79.87	4.89	bc
District 5	43	3,180	87.29	3.74	a
District 6	20	1,213	90.55	4.37	a
District 7	22	1,545	87.69	4.99	a
District 8	13	2,683	86.59	4.60	ab
District 9	24	1,854	77.23	5.94	c

Table 24. Implementation rate by physiographic region

Region	Number of Tracts	Acres	Implementation Percent	Margin of Error	Statistical Significance*
Ozark	40	4,301	86.66	3.49	a
Ouachita	70	5,673	86.38	3.21	a
Southwest	146	12,399	85.63	2.32	a
Delta	18	1,857	88.36	5.17	a

*Implementation percents having a different significance letter are significantly different at the 5 percent probability level.

Table 25. Implementation Rate by Ownership and Year

Survey Year	Land Ownership Category			
	PNIFLO	Industrial	Federal	State
2007-2008	81%	89%	99%	93%
2005-2006	81%	90%	96%	95%*
2002-2003	80%	93%	99%	96%
2000-2001	74%	88%	96%	92%
1998-1999	75%	87%	96%	82%
1996-1997	81%	89%	99%	89%

*Separate analysis from other Ownership.

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Stamps, AR 71860
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Clarksville, AR 72830
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72560
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District 8 Office
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Ash Flat, AR 72513
(870) 994-2187

District 9 Office
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Greenbrier, AR 72058
(501) 679-2806

WOOD HARVEST AND DISTRIBUTION OF MONITORING SITES

Delta Region	2001 Annual Harvest (Tons)	Number of Sites
Arkansas	139033	2
Chicot	52747	1
Clay	29827	0
Craighead	14216	0
Crittenden	37652	0
Cross	21755	0
Desha	384474	3
Greene	7540	0
Jackson	3996	1
Jefferson	480591	3
Lawrence	10407	0
Lee	71484	0
Lincoln	268445	4
Lonoke	31660	0
Mississippi	1724	0
Monroe	45450	0
Phillips	63922	0
Poinsett	19022	0
Prairie	51795	0
St. Francis	25985	0
Woodruff	5746	0
Total Delta	1,767,471/8%	14/7%

Ouachita Region	2001 Annual Harvest (Tons)	Number of Sites
Garland	306797	4
Logan	102827	3
Montgomery	432868	2
Perry	290474	5
Polk	282686	6
Pulaski	154178	2
Saline	340414	5
Scott	421311	6
Yell	443032	5
Total Ouachita	2774587/12%	38/14%

Ozark Region	2001 Annual Harvest (Tons)	Number of Sites
Baxter	19677	0
Benton	6986	0
Boone	24318	0
Carroll	24318	0
Cleburne	300060	3
Conway	186057	2
Crawford	26982	0
Faulkner	47525	2

Ozark Region	2001 Annual Harvest (Tons)	Number of Sites
Franklin	40790	1
Fulton	8327	0
Independence	127,366	2
Izard	48,681	1
Johnson	145,008	3
Madison	94,934	1
Marion	40,319	1
Newton	73,542	2
Pope	158,623	4
Randolph	17,973	0
Searcy	62,024	2
Sebastian	44,666	0
Sharp	41,620	0
Stone	146,324	2
Van Buren	184,150	6
Washington	47,487	1
White	134,849	2
Total Ozark	2,053,149/ 9%	23 / 9%

Southwest Region	2001 Annual Harvest (Tons)	Number of Sites
Ashley	1,198,231	13
Bradley	1,177,990	12
Calhoun	633,741	8
Clark	979,084	11
Cleveland	867,300	10
Columbia	806,377	11
Dallas	1,033,203	9
Drew	1,154,349	10
Grant	1,694,837	13
Hempstead	557,431	5
Hot Spring	375,791	3
Howard	663,477	8
Lafayette	429,235	6
Little River	434,329	3
Miller	534,150	3
Nevada	570,729	10
Ouachita	891,534	9
Pike	569,418	6
Sevier	578,289	8
Union	1,448,257	16
Total	16,597,752 / 72%	174 / 70%
Grant Total State-2001	23,192,599 / 100%	249 / 100%



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