



## Mississippi Department of Transportation

# Equipment Management Review

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## Final Recommendation Report



November 2013



**Mississippi Department of Transportation**

**Equipment Management Review**

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## Executive Summary



The Mississippi Department of Transportation (MDOT) hired Dye Management Group (DMG) to review its equipment management processes and systems to identify areas for improvement and efficiency. As part of the project, DMG interviewed key stakeholders, documented current MDOT equipment management business processes and industry best practices, performed a gap analysis to identify areas for improvement, and conducted a high-level benefit-cost analysis of the rent/lease versus buy decision for key equipment classes.

DMG presented the findings at an executive committee workshop for feedback and comment prior to moving forward with development of the final model and recommendations. Upon approval of our initial findings, DMG proceeded to develop the updated equipment management model.

Results of the high-level benefit-cost analysis indicate several opportunities for cost savings by supplementing MDOT-owned equipment with rental/lease equipment. Rental/lease options allow MDOT to maintain access to necessary equipment while streamlining its fleet. Specifically, we recommend that MDOT supplement the current MDOT-owned motor grader 0 to 125hp and 126+hp fleets with rental options as the current fleet is coming due for replacement. We also recommend that MDOT supplement the bulldozer fleet with rental equipment. These recommendations are based on historical usage, acquisition and operating costs, average age and estimated useful life of the fleet, and currently available rental options. DMG recommends MDOT maintain a minimum level of agency-owned equipment for efficient emergency response.

We have recommended additional improvements to the agency's equipment management process. These include short-term actions:

- Establish minimum equipment utilization standards
- Request long-term rental/lease options to negotiate better rental rates and maximize potential savings opportunities
- Perform pilot to evaluate the benefits of GPS implementation
- Centralize fleet auctions
- Continue to monitor fuel quality

Long-term recommendations include:

- Move towards a centralized equipment management system

- Develop a best-value, rather than low-bid, procurement process.

# I. Introduction



## A. Purpose

MDOT hired DMG to review its equipment management processes and systems to identify areas for improvement and efficiency. Specifically, DMG was asked to investigate current equipment management best practices and analyze the rent/lease versus buy decision for key equipment classes.

## B. Approach

To begin the project, DMG interviewed district equipment supervisors and key project stakeholders. These interviews enabled DMG to identify and document current MDOT equipment management business processes. We followed the equipment life cycle through purchasing and procurement, equipment use and preventive maintenance, and, finally, equipment sale or retirement.

Additionally, DMG documented industry best practices and compared these against current MDOT processes. Our analysis focused on equipment utilization, a key component of effective fleet management. Based on our research, we identified productive, reasonable equipment utilization rates applied at other DOTs to help MDOT develop a set of equipment utilization standards. We then identified methodologies used at other transportation agencies to guide the “rent/lease versus buy” decision and determined the feasibility of applying similar approaches at MDOT.

DMG then performed a gap analysis to identify areas for improvement to the current MDOT equipment management business processes. As part of this process, we performed a high-level benefit-cost analysis for key equipment classes to develop a recommended equipment management model, summary report, and implementation plan for MDOT. DMG also documented the benefit-cost analysis process for MDOT to use to conduct future benefit-cost analyses as its data inputs continue to evolve and improve.

## C. Contents

This report includes:

- A summary and flow chart that document current MDOT equipment management business processes
- A summary of industry best practices

- Documentation of the equipment utilization rate development process
- Documentation of the equipment rent/lease-buy benefit-cost analysis process
- Benefit-cost analysis results and recommendations
- Benefit-cost analysis conclusions
- High-level findings and recommendations
- An implementation plan to execute recommendations

## II. . MDOT Equipment Management Business Processes



To document current MDOT equipment management business processes, DMG reviewed relevant agency documents and interviewed district equipment supervisors. We categorized the processes into three areas of the equipment management cycle: purchasing and procurement; equipment use and preventive maintenance; and equipment sale and retirement. The following summarizes the results. Appendix II provides the current MDOT equipment management business process flow chart.

### A. Purchasing/Procurement

During our workshop with district equipment supervisors, we learned that most equipment is purchased, as opposed to rented, leased, or shared between districts. Vehicle and equipment purchases are funded from two sources: the annual budget or the MDOT Equipment Purchase Fund, known internally as the Equipment Revolving Fund. Proceeds from the sale of equipment and vehicles are deposited into the revolving fund and new vehicle and equipment purchases may be made from this fund. Purchases can be made through the requisition/purchase order process or through the Master Lease Purchase (MLP) Plan. The MLP is a financing plan that the Department of Finance and Administration coordinates for the state of Mississippi. The MLP is similar to an installment loan and MDOT makes semi-annual payments over two- to five-year terms. The MLP is generally used for the purchase of expensive items so that the annual equipment budget is not fully depleted with a single purchase. We found districts vary in how often they use the fund.

Vehicle and equipment purchases are made through a low-bid procurement process. Due to limited flexibility in new equipment purchasing, a vehicle or piece of equipment may be repaired, rather than replaced. As a result, supervisors may devote more funds to equipment repairs than the equipment is worth. Equipment expenditures are divided into three budget categories:

- Contractual: Services. Rental equipment falls into this category.
- Commodities: Tangible items that do not require capitalization. Parts and supplies fall into this category.
- Capital outlay: Tangible items that cost \$1,000 or more or that require capitalization, regardless of cost. Vehicle and equipment purchases fall into this category.

These budgets affect the rent/lease versus buy decision in that equipment superintendents may not have sufficient funds in their capital budgets to purchase new vehicles and/or equipment. As a result, they may be “forced” to use funds from the contractual or commodities budget to repair equipment that is beyond its useful life or is not worth the

amount of repairs invested. MDOT does not often use the equipment rental contract to manage equipment; it typically opts to rent/lease equipment only in emergency situations.

## B. Equipment Use/Preventive Maintenance

MDOT utilizes an equipment management system (EMS) to track service histories, parts, labor, tasks, warranties, and invoices. EMS interfaces with several systems, including the financial management system (FMS). MDOT uses EMS to assign work, manage tasks, compile data, and measure performance. EMS performance metrics include:

- Completed service calls
- Fuelman work orders
- Overdue preventive maintenance
- Work orders open greater than two months
- EMS users
- Inactive maintenance

Depending on the type of equipment, required repair, and equipment location, the equipment may need to be transferred out of the district or state for repairs.

## C. Equipment Sale/Retirement

MDOT utilizes five methods for asset disposal:

- Sealed-bid sale
  - Offered to other governmental agencies throughout the state prior to holding public sale
- Public auction
  - Usually conducted once a year at each district headquarters
  - MDOT policy is to offer all assets marked for “sale at auction” to governmental entities throughout the state of Mississippi before holding public sales
  - Some vehicles and specialized equipment are sold through public auction companies at various times throughout the year
  - Minimum equipment usage requirements must be met prior to sale
- Mississippi Office of Surplus Property (OSP)
  - Usable office, computer, and telecommunications equipment deemed surplus to MDOT’s needs and other assets and that generally lack an appreciable resale market value will be transferred to OSP.
- Transfer/sale to other state or local governmental entities
- Scrapping/junking
  - Property custodians identify assets that are obsolete, worn out, not salvageable, and have no residual value.
  - Property custodians must complete deletion paperwork; the Asset Management Division (AMD) will delete the scrapped or junked assets in FMS.

- Property custodian will remove all MDOT marking, destroy the asset, and discard it appropriately (dumpster, scrap metal bin, etc.).
- Items that are “scrapped for parts” may be retained. Such items must be clearly marked “scrapped for parts” and the property decals shall be removed.
- Items that are removed from inventory and used for spare parts are generally small equipment items, such as weed eaters and chain saws.

General notes concerning MDOT Disposals:

- Proceeds from the disposal of surplus MDOT assets (via sealed bid, sale to another governmental entity, or public auction) are forwarded to the Financial Management Division for deposit into the MDOT Equipment Revolving Fund.
- MDOT equipment crews sometimes remove parts (service bodies, cranes, buckets, etc.) from old trucks and re-use them on new trucks. They then sell just the truck chassis or put a spare bed on it.

### III. Summary of Industry Best Practices



The following describes the results of industry best practices research that DMG conducted on elements of equipment management processes. Specifically, we focused our research on life cycle cost analysis (LCCA) and optimum fleet replacement schedules; fleet leasing options; GPS unit installation; and low-bid versus best value procurement. As part of the process, we contacted equipment and fleet managers currently leading highly effective fleet management practices. Based on our research, we have identified areas for improvement to MDOT's current equipment management processes. This gap analysis will guide MDOT in their equipment management process updates and work to improve their fleet operations. DMG understands that several proposed changes may require legislative approval. MDOT can use these findings to support agency requests for updates or amendments to existing statutes and/or policies.

#### A. Establish Optimum Fleet Utilization and Replacement Schedules

Optimum fleet utilization and replacement schedules enable fleet management offices to maximize returns at auction and maintain more efficient fleets. The incorporation of LCCA into equipment replacement schedules enables organizations to minimize the life cycle costs of the fleet and optimize the fleet replacement schedule. High-performing agencies have developed replacement schedules that optimize the length of time and amount of usage for equipment and fleet vehicles. These schedules are developed based on historical maintenance and operating costs in order to minimize life cycle costs and maximize sale prices at auction. However, some agencies—MDOT included—are required to keep equipment for a minimum number of years and/or miles/hours, which makes optimization of the replacement schedule a challenge.

To better understand LCCA and fleet utilization and replacement best practices, we identified high-performing fleet management offices and documented their processes. Officials at the Alabama Department of Transportation (ALDOT) have developed replacement schedules that significantly reduced the mileage/hours at which they schedule equipment for replacement. ALDOT bases its replacement schedules and utilization rates on data captured in its internally-developed comprehensive equipment management system (CEMS). The CEMS tracks data elements, such as fuel purchases, equipment mileage, monthly equipment usage, and maintenance histories. The historical data allows ALDOT to establish estimated utilization rates for equipment and to identify points on the life cycle cost curve where maintenance and operating costs begin to peak. ALDOT can thereby identify underutilized equipment and schedule stock for auction at usage levels that maximize resale values. Replacement schedules are also automated, which removes subjectivity

from the purchasing decision. ALDOT representatives reported that the process enables the agency to maximize returns at auction and keeps the fleet modern and efficient.

ALDOT's system and processes afford it numerous benefits. Closely monitored utilization rates enable ALDOT officials to reduce fleet size to more efficient levels. Quicker fleet turnover means that much of the equipment maintenance is still under warranty from vendors. A more modern fleet also improves fuel efficiency. Lastly, the replacement schedules enable staff to better plan and budget, as supervisors and purchasers can accurately predict the replacement dates for equipment.

The Ohio DOT develops equipment standard utilization rates that are based on historical and current information for accumulated costs, hour readings, and odometer readings, where applicable.

Miles driven is defined as the average of the total mileage driven over the last five years. This average is used to account for possible mileage anomalies that may occur as a result of abnormal seasons (light or severe weather) or various yearly projects. Fiscal year (FY) total cost is defined as the last FY total operational cost (direct stock, direct fuel, direct labor, equipment depreciation, and applied overhead cost).

The city of Columbus, Ohio Division of Fleet Management presented at the 2012 Government Fleet Expo and Conference. The division uses several criteria to determine the order of fleet replacement, including age, maintenance history, and vehicles with greater than 100,000 miles driven. Additionally, the division generates an underutilization report every two years. This report, coupled with discussions with divisions and justification reporting, generally leads to the decommissioning or reassignment of fifty to one hundred vehicles, which reduces the overall fleet size. In the future, GPS data will be used to drive replacement needs.

Lessons learned from the Columbus example include:

- Conduct LCCA in order to use data to drive the vehicle replacement budget each year.
- Do not delay fleet replacement because short-term savings are not worth the long-term costs.

The Columbus LCCA process incorporates capital and operating costs and includes a depreciation rate. The Columbus model states that lifetime maintenance costs should be less than fifty percent of acquisition costs.

## B. Fleet Leasing and Rental Options

One option to reduce fleet size is to lease or rent vehicles and equipment, rather than purchase them. There are essentially two types of leasing options for public agencies: capital (finance) leases and operating leases. Capital leases are considered equivalent to a purchase, while operating leases cover the use of an asset for a period of time and are treated by the lessee as periodic expenses.

Leasing companies generally recover most of the capital cost over the life of the vehicle with capital leasing arrangements. Often, the asset must be retained for a minimum of twelve months, but can be turned in any time before or after the planned lease term.

Lease terms typically range from forty-eight to eighty-four months. The lessee bears the risks of “losses” in the residual values when the vehicle is sold, but also receives “gains” when the vehicle is sold for more than the current amortized book value. Individual retail customers frequently use closed-end leases. These leases generally have a fixed number of months in the lease term. The lessee bears no risk relative to the residual value of the asset, but many closed-end leases have fixed mileage limits and contain fees for abnormal wear and tear. Organizations can also utilize leasing options to generate cash while replacing aging equipment. Sale/lease-back arrangements enable an organization to sell assets to a leasing company and lease them back.

Fleet lease and rental options provide access to necessary vehicles and equipment without the large capital expense of purchasing and can thereby supplement an agency-owned fleet. Lease and rental options can also serve as a reserve resource. Weather emergencies and local disasters can strain a fleet and push equipment needs beyond a fleet’s capacity. A streamlined fleet may occasionally run short of vehicles and/or equipment. However, fleet managers can arrange rental vehicles and equipment as necessary. Rental or short-term lease agreements can also provide specialty equipment that an agency may not need to keep full-time. Rentals can also be an effective means for covering seasonal equipment demands. Extra pickups may be arranged through short-term lease agreements in order to supplement busy seasons. An open purchase order with local equipment and vehicle rental agencies can provide the extra resources quickly.

The state of Ohio’s Division of Administrative Services Fleet Management Office analyzed the lifetime costs of purchased versus leased passenger vehicles. The vehicles analyzed range from compact sedans to fifteen passenger vans. Ohio’s analysis indicates lower life cycle costs for leasing versus purchasing vehicles. Lifetime costs savings range from approximately 6.25 percent (\$2,589) for mini passenger vans to nearly 17 percent (\$9,071) for fifteen passenger vans. Savings from leasing compact sedans are estimated at 12.3 percent (\$3,348) and at 8.8 percent (\$2,779) from leasing mid-size sedans.

The state of Missouri developed a Smart Lease Vehicle Program, which provides a mechanism by which state agencies can transfer employee business miles from high-cost mileage reimbursement to a state-owned, leased purchased vehicle to generate cost savings. At the time the program was developed, the state did not have money to purchase new vehicles. However, as a result of the Smart Lease Vehicle Program, they transferred over 3.2 million business miles from mileage reimbursement to lease purchased vehicles, which saved the state over \$660,000 annually.

From FY 2003 to FY 2006, Missouri's cost to own and operate a sedan was between 19.2 cents and 22.5 cents per mile. The state had not historically utilized tax-exempt financing for lease-purchasing equipment or vehicles. As a result, it typically financed equipment purchases at rates that averaged nearly eight percent. State representatives contacted potential lessors to learn about tax-exempt programs and received preliminary interest rate quotes in the range of 3 to 3.2 percent. Additionally, the state found that the cost to lease was only 1.3 cents per mile more than the cost to purchase a vehicle outright. During the analysis period, Missouri found that the operational costs of a Smart Lease vehicle were 25.8 cents per mile, rather than 45.5 cents per mile for mileage reimbursement.

Through the procurement process, the team was able to secure more favorable terms in the master lease contract than under similar financing programs, in that the lessor did not retain a security interest in the equipment or hold title to vehicles during the repayment period.

Benefits include:

- Interest savings over fifty percent by combining the purchasing power of all state agencies
- A single contracted financing vendor, which simplifies the bid evaluation process for OA/Purchasing because they no longer need to individually analyze the financing component of bids
- State owns the equipment
- Financing is not considered debt

While this program focuses on passenger vehicles and may not be directly applicable to MDOT, the lessons learned can serve the agency well:

- Leasing can supplement agency-owned fleets when money to purchase new vehicles is not available
- Investigate tax-exempt financing for lease-purchasing
- Work with other state agencies to combine purchasing power and realize cost savings

The state of Michigan currently leases more vehicles than it owns. In 2012, the state owned 4,701 vehicles and heavy equipment and leased 7,294 motorized vehicles. A representative from the Michigan Department of Technology, Management, and Budget stated that operating leases have smoothed cash flow requirements, based upon regular monthly rental payments, rather than periodic capital investment for direct vehicle purchases. Michigan noted the program has removed obstacles to federal reimbursement for vehicle replacement and fleet growth, as there is no need to accumulate funds for these purposes. The removal of obstacles to federal reimbursement has improved the cost and administrative efficiencies of the state of Michigan's fleet operation and has optimized depreciation management.

Michigan representatives stressed the importance of establishing optimum lease terms. Michigan established replacement criteria for all vehicles, and the lease terms are aligned accordingly. For example, passenger vehicles are replaced after 100,000 miles and lease terms are sixty months. Michigan analyzed mileage patterns, maintenance, and down time to establish break even points for turn-in and lease terms. Currently, Michigan lease terms range from twenty-four to eighty months. In an effort to maximize savings, Michigan has also contracted for comprehensive fleet management services, which include leasing, fuel, maintenance, accident and collision coverage, subrogation, and data management. As a result, Michigan has realized significant administrative efficiencies because it has approximately 7,000 maintenance transactions per month but pays one monthly bill to the fleet management company.

### C. Utilize GPS

As part of our research on GPS implementation, DMG consulted a 2011 document published by the California DOT (Caltrans) that investigated GPS and automatic vehicle location (AVL) implementation at state DOTs. Caltrans found that states primarily use GPS systems on snow plows, for AVL during storms, and to track salt application and weather and road condition data. Additionally, the Indiana and Oregon DOTs use GPS to monitor engine idling; the Iowa and Oregon DOTs use GPS to track equipment diagnostics; and the Oregon and Washington DOTs developed plans to expand their use of GPS to track equipment diagnostics for maintenance purposes. The Iowa DOT conducted a benefit-cost analysis on its GPS implementation and calculated a benefit-cost ratio of 6.4 to 1. Specific benefits cited in the research include, but are not limited to:

- Reduced labor, equipment, and material costs
- Reduced paperwork
- Reduced reliance on radio communications
- Improved tracking for emergency response
- Improved roadway safety
- Reduced traffic delay
- More accurate data on vehicle operations, road conditions, and material/fuel usage

Reduced tort liability was also cited as a benefit because an organization is able to provide the exact dates, times, and quantities of plowing, sanding, and deicing operations. Also reported were several common problems associated with GPS implementation:

- Lack of adequate cell/data coverage
- Software malfunctions
- Software compatibility issues or other installation problems
- End-user training issues
- End-user perception or morale
- Hardware problems
- Cost

The identification of potential issues in advance enables MDOT to develop plans to mitigate these risks.

We also obtained information from the Arkansas State Highway and Transportation Department (AHTD) on its GPS pilot program. AHTD installed Networkfleet's GPS with diagnostics on twelve units for a ninety day pilot. Networkfleet's plug and play units allowed for easy installation that took approximately thirty to forty-five minutes per vehicle. AHTD cited several benefits of GPS utilization, including: increased emphasis on driver behavior; increased safety; reduced liability; decreased fuel costs; and increased efficiency. Specifically, installation of the GPS units greatly reduced speeding, excessive idling, miles driven, and also increased fuel efficiency.

By monitoring worker activity, AHTD was able to limit unnecessary miles driven, which allowed for more precise work scheduling and shorter job completion times. Information presented at the 2013 Southeastern States Equipment Managers Conference notes that, following GPS implementation, AHTD is on pace to reduce vehicle miles driven by approximately twelve percent. Based on historical usage and cost data, AHTD calculated that the cost to operate its vehicles is approximately \$0.25 per mile. The reductions in miles driven results in fuel savings and reduced maintenance and repair costs. GPS implementation has resulted in an annual financial benefit of \$480 per vehicle and over \$1.15 million for the entire fleet. Lastly, Networkfleet's units alert AHTD of diagnostic trouble codes (DTC), which help keep department personnel informed of immediate vehicle maintenance needs and thus reduce repair costs and equipment down time. The AHTD program also includes roadside assistance for all vehicles, when needed, for up to four occurrences per vehicle per year.

ALDOT has also deployed GPS technology in several fleet vehicles and equipment. Division heads have discretion over which pieces of equipment/vehicles will have GPS deployed in them. ALDOT reported that the use of GPS to monitor vehicle has reduced fuel costs and mileage and saved the department approximately \$1.4 million per year. ALDOT feels that GPS encourages employees to be more productive. ALDOT has also used GPS to exonerate employees of wrongdoing.

## D. Centralized Equipment/Fleet Equipment Management and Purchasing

Another possible efficiency is for MDOT to take a more centralized approach to equipment management and procurement. ALDOT has centralized all equipment management and purchasing under the Bureau of Equipment and Services, which owns all ALDOT fleet vehicles and equipment and rents the pieces to each division. The Bureau of Equipment and Services charges divisions minimum usage fees or rates to utilize each piece of equipment, which encourages divisions to fully utilize equipment because they pay minimum usage rental rates regardless of the amount of utilization. ALDOT notes the minimum usage rental rates reduce underutilization and can be used to streamline the fleet, since divisions may not request new equipment if they know it will be a budget drain. Centralized equipment management and purchasing also enables ALDOT to streamline the procurement process, purchase large quantities of equipment, and realize increased purchasing power and lower prices. The Bureau of Equipment and Services can analyze utilization rates and determine if a piece of equipment should be replaced. ALDOT reported significant cost savings as a result of its centralized equipment management process.

## E. Best Value versus Low-bid Procurement Processes

The Federal Acquisition Regulation (FAR) system guidelines, published by the General Services Administration (GSA), provide guidance for best value procurement processes. In addition to the bid price, the FAR guidelines detail several components to consider for best value procurement. These include:

- Item characteristics
- Past performance
- Warranty
- Ownership costs
- Maintenance availability
- Useful life
- Environmental and energy efficiency
- Technical qualifications
- Transportation costs
- Administrative costs
- Delivery and performance terms

Each of these components are detailed in the FAR guidelines and direct agencies to consider such elements of bids as historical repair costs for various pieces of equipment, location of equipment repair and/or maintenance facilities, and the difference in equipment delivery costs between different vendors. These guidelines incorporate elements of LCCA into the procurement process to ensure that organizations purchase equipment and other items that have low total life cycle costs, not just the lowest purchase prices.

The Michigan DOT incorporates best value techniques into their procurement guidelines. The Michigan DOT utilizes a tradeoff process in its procurement methods that no longer emphasizes the definition of an organization's minimum needs. Rather, agencies are encouraged to structure selection procedures according to the realities of their requirements. They are not expected to fit all acquisitions into a lowest-price-available proposal mold when it may cause unacceptable performance risks or higher total life cycle costs. The Michigan DOT notes that it is important that the perceived benefits of a higher-priced proposal merit the additional cost and that the rationale for tradeoffs be documented in the bid documents. Vendor scores that lack substantive explanations of the relative strengths and weaknesses of the competitive proposals, including the perceived benefits to the agency, are an insufficient basis for paying a higher price.

## **F. Fleet Auctions**

There are multiple types of vehicle and equipment auctions. Traditionally, agencies utilized onsite auctions to sell surplus equipment. Recently, several agencies have also utilized online auctions to maximize the resale prices. Additionally, online auctions can be conducted on an international scale, which broadens the clientele base, and drives up bids.

ALDOT typically conducts two equipment auctions per year from a centralized location and uses local maintenance shops to prepare equipment for auction, which benefits the local economy. ALDOT is under contract with a local auction company that handles the entire auction process at a rate of 4.7 percent per transaction. During the auctions, ALDOT representatives are on-site to interact with attendees, answer questions, etc. The benefits of contracting the auction services include access to the auction company's marketing services and international client base.

The state of New York operates a website called NYSSStore.com, which sells surplus government property via eBay-based online auctions. The utilization of eBay or a similar online auction site should enable MDOT to broaden its clientele base and increase auction revenues. On such auction sites, surplus property can be sold with a "buy it now" price or by auction with a minimum price.

Note: MDOT currently delivers certain specialized equipment to commercial public auction companies in order to realize the benefits of an increased buyer pool and international bidding.

## **G. Monitor Fuel Quality and Utilize Alternative Fuels**

In an effort to improve fuel mileage and reduce carbon emissions, several agencies, including ALDOT, have begun to monitor fuel quality and incorporate alternative fueling options into their fleets. For example, ALDOT has developed a policy to purchase ethanol fuel vehicles, if available. ALDOT cited increased vehicle performance from ethanol vehicles.

Additionally, ALDOT implemented a system to monitor diesel fuel quality. When ALDOT receives a diesel fuel order, a sample is taken and sent to a testing center to evaluate the quality. Based on the results, ALDOT can alert a vendor of sub-standard quality fuel. At present, ALDOT does not have a policy to reject substandard quality fuel. However, ALDOT representatives reported that the testing serves as a check on the fuel vendor.

Note: MDOT currently monitors diesel fuel to test cetane levels. MDOT also adds fuel additives to increase fuel mileage and prolong engine life.

## IV. Equipment Utilization Rate Development Process



One component of an effective equipment management process is the development of standard equipment utilization rates to monitor equipment usage and identify underutilized equipment. The following documents the process to develop standard equipment utilization rates. This process will first be implemented on the nine “key” equipment classes, but can easily be applied to all major and minor equipment class codes.

The MDOT financial management system (FMS) houses all the necessary data and reports to develop equipment utilization standards. Maintenance equipment usage data is entered into the AMMO system and feeds directly into the FMS. While several reports are available that contain components of the necessary data, the Equipment Cost and Usage by FY Computed Rate Report contains two fiscal years of usage and operating cost data, as well as life-to-date usage data and operating costs. While the analysis of additional years of historical equipment usage data is preferred, the MDOT team felt particularly confident in the quality of the last two years of data. In the future, MDOT can add additional years of historical data to the report to further refine its utilization standards.

This current report is sufficient to conduct the utilization analysis. However, we recommend that MDOT work with Information Systems (IS) to add the usage standards as fields in the FMS reports. In FMS, the class code maintenance window already has fields for replacement life expectancy and replacement index. MDOT should work with IS to activate these fields and to add the replacement life expectancy to FMS reports.

We also recommend that MDOT develop a custom “Equipment Utilization” report. MDOT should also consider developing an “Equipment Underutilization Report” that incorporates the utilization standards to identify equipment not to be replaced. These reports should include the functionality to filter reports by location and sub-location in order to enable districts to easily access their specific equipment utilization reports. MDOT is currently developing a report dashboard to provide end-users with quick access to their various reports. We recommend that MDOT continue to develop the dashboard and add the equipment utilization reports, once completed.

The following steps outline the process to develop equipment utilization standards.

1. Open FMS
2. Run the Equipment Cost and Usage by FY Computed Rate Report
3. Request the report from FMS in Excel format in order to easily manipulate the data
4. Remove the equipment entries with zero usage and/or cost

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5. Average the two previous years' usage to establish a baseline for determining minimum usage standards

The director of the Asset Management Division, Julie Ethridge, should initially perform this process and work with IS to implement the minimum standards. Additionally, we recommend that an executive committee workshop confirm that the calculated statewide minimum usage standards are appropriate. We also recommend that the executive committee meet to determine the appropriate utilization rate. For instance, ALDOT uses a fifty percent rate as its standard. If a piece of equipment is utilized at 45 percent of the statewide standard, it will not be replaced.

The process described will enable MDOT to establish minimum usage standards and appropriate utilization rates. These standards will allow MDOT to identify underutilized equipment that is not a candidate to be replaced at the end of its useful life.

## V. Summary of Equipment Rent/Lease-Buy Benefit-cost Analysis Process and Results



DMG performed a high-level benefit-cost analysis of the rent-lease-buy decision for new equipment procurement. The steps below describe the general process we followed for our analysis. We performed a high-level analysis for nine “key” equipment classes, the results for which are included in Appendix I. However, MDOT can easily apply the same process to all major and minor equipment class codes in the future. The following summary section includes a more detailed description of the benefit-cost analysis process and summarized results for the motor grader and bulldozer equipment classes. Lastly, we have included other recommendations that are based on the results of our analysis.

### A. Description of General Benefit-Cost Analysis Process

1. Identify major/minor equipment classes for replacement analysis.
  - DMG conducted a high-level, statewide benefit-cost analysis of the nine “key” equipment classes that MDOT identified. The process can be repeated on any major and/or minor equipment class.
  - Users can sort by district, if desired.
2. Run the Equipment Cost & Usage Report by FY Computed Rate Report in FMS.
  - DMG looked at two years of historical data, current year-to-date (YTD) stats, and life-to-date usage and operating costs.
  - We also included acquisition costs, acquisition date, and historical average resale values. As more quality data is entered into FMS, the analysis period can include additional years of data. Deduct fuel costs from the total operating costs to accurately compare ownership to rental costs.
3. Sum and average the usage and cost totals (DMG used statewide totals for our high-level analysis).
  - Calculate: Total cost of ownership = life-to-date operating costs + current estimated acquisition cost – estimated resale value
    - Deduct fuel costs from operating costs.
    - DMG used the average equipment fuel costs in our analysis.
  - Average the total cost of ownership

- Divide the average total cost of ownership by the average age of equipment (in years) to determine the average total cost of ownership per year.
  - DMG averaged the 2012 and 2013 FY, as well as the life-to-date usage and cost totals for our high-level analysis.
4. Utilize the information from the equipment rental contracts.
- DMG used the 7-1-2012 through 6-30-2013 and 7-1-2013 through 6-30-2014 documents for our analysis. Users should use the most recent rental contracts available.
  - The rental contracts detail bids for rental equipment from vendors by day, week, and month.
    - Average the rental rates or use the best rental rate available and/or nearest vendor.
  - The rental contracts list delivery charges, based on distance from vendor.
    - DMG developed spreadsheets with columns for various distances from vendor (25, 50, 100, 250, and 500 miles). We also averaged the delivery charges for our analysis.
    - Districts can estimate their delivery charges, based on distance from vendor.
  - Request that the reports be sent in Excel in order to easily populate the spreadsheets and manipulate data.
  - Sum and average the total rental costs, including rental rates and delivery charges.
5. Identify and apply risk factors for emergency vehicles.
- MDOT should apply risk factors to vehicles and equipment that are necessary in emergency situations.
6. Compare the total costs of ownership to the rental rates.
- DMG averaged the total costs of ownership and rental rates for our high-level statewide analysis. As a result, minimum usage thresholds may not apply to some equipment classes.
  - Districts can use specific rates in their analysis.
7. We recommend a 10 percent threshold between total costs of ownership and total rental costs.
- If the costs to own vehicles and equipment are within 10 percent of the costs to rent, we recommend that the districts make the rent-lease-buy decision.
  - If ownership costs are greater than 10 percent of the rental costs, central administration should make the rent-lease-buy decision.

## VI. Benefit-Cost Analysis Results and Recommendations



DMG performed a high-level benefit-cost analysis on the “key” equipment classes that MDOT provided. DMG also performed an in-depth benefit-cost analysis on the motor grader and bulldozer equipment classes. There are several instances of missing or incomplete data that do not allow a thorough benefit-cost analysis to be performed. However, as data entries continue to improve, MDOT can use the benefit-cost analysis process previously described to conduct an in-depth benefit-cost analysis in the future.

It is important to note the need to maintain a minimum level of key equipment and vehicles for necessary in emergency response situations. DMG recommends MDOT conduct a workshop to identify key emergency response equipment and set minimum required inventory totals to ensure efficient emergency responses.

### A. Motor Graders

MDOT specifically asked DMG to analyze the motor grader equipment rent/lease versus buy decision. DMG followed the benefit-cost analysis process described above to identify any potential efficiencies in the replacement process.

Our findings indicate that the motor grader (0 to 125hp) class is a strong candidate for renting in the future. High acquisition costs of \$125,000, as estimated by MDOT staff, and relatively low usage rates drive this decision. Our analysis found a life-to-date average annual usage of 245 hours, or approximately 31 (8) hour workdays. We also calculated an average total cost of ownership of \$6,294 per year. Based on the rental contract quotes MDOT provided, we calculated that a statewide average rental rate for a similar class motor grader is \$5,209 per month. This number includes average round-trip delivery charges at several distances from the vendor (25, 50, 100, 250, and 500 miles).

We used a one month rental plan to estimate a statewide average annual savings of \$1,085 per motor grader. The 17 percent savings is within the 10 percent threshold we recommend for the rent/lease versus buy decision. The distance from the vendor strongly affects the benefit-cost result. For instance, if a district is located 500 miles from the equipment vendor, we estimate an

annual loss of \$1,481 per motor grader. However, if a district is located 100 miles from the equipment vendor, we estimate an annual savings of \$1,819 per motor grader. We estimate an average life cycle cost savings of over \$30,000 per unit. For a district within 100 miles of the equipment vendor, we estimate an average life cycle cost savings of over \$50,000 per unit.

If scheduling conflicts do not allow for a one month rental, a district could secure a two month rental. However, a two-month rental will negate any rental savings noted above. We estimate that a two month rental would result in an annual loss of \$2,656 per motor grader for a district located 100 miles from a vendor if no multi-month discounted rate exists. It is important to note that the 2012 and 2013 FY equipment usage reports show an average annual usage of 135 hours, or approximately 17 (8) hour workdays. We feel that efficient maintenance activity and equipment scheduling can allow districts to utilize a one month rental option. Exhibit 1 and Exhibit 2 detail the results of our benefit-cost analysis on the 0 to 125hp motor grader equipment class.

### Exhibit 1: Daily, Weekly, and Monthly Rental Options Motor Grader (0 to 125hp)

Daily, Weekly, and Monthly Rental Options Motor Grader (0 to 125hp)								
Miles to Vendor	Rental Price per Day	Rental Price per Week	Rental Price per Month	Annual Total Ownership Costs	Annual Savings per Unit	Annual Savings to Current Fleet Size (17 units)	Life cycle Cost Savings per Unit (28 years)	Life cycle Cost Savings to Current Fleet Size (17 units)
25	\$849	\$1,671	\$3,994	\$6,294	\$2,300	\$39,104	\$64,407	\$1,094,919
50	\$943	\$1,765	\$4,088	\$6,294	\$2,207	\$37,511	\$61,782	\$1,050,294
100	\$1,330	\$2,153	\$4,475	\$6,294	\$1,819	\$30,923	\$50,932	\$865,844
250	\$2,568	\$3,390	\$5,713	\$6,294	\$582	\$9,886	\$16,282	\$276,794
500	\$4,630	\$5,453	\$7,775	\$6,294	(\$1,481)	(\$25,177)	(\$41,468)	(\$704,956)
				Average	\$1,085	\$18,449	\$30,387	\$516,579

Note: Previous 2 FY average annual usage of 135 hours, or approximately 17 (8) hour days. Average life-to-date annual usage of 245 hours or approximately 31 (8) hour days. All figures shown are statewide averages.

### Exhibit 2: Daily, Weekly, and Monthly Rental Options Motor Grader (0 to 125hp)

Two Month Rental Option Motor Grader (0 to 125hp)								
Miles to Vendor	Rental Price per Day	Rental Price per Week	Two Month Rental	Annual Total Ownership Costs	Annual Savings per Unit	Annual Savings to Current Fleet Size (17 units)	Life cycle Cost Savings per Unit (28 years)	Life cycle Cost Savings to Current Fleet Size (17 units)
25	N/A	N/A	\$7,988	\$6,294	(\$1,694)	(\$28,790)	(\$47,418)	(\$806,106)
50	N/A	N/A	\$8,175	\$6,294	(\$1,881)	(\$31,977)	(\$52,668)	(\$895,356)
100	N/A	N/A	\$8,950	\$6,294	(\$2,656)	(\$45,152)	(\$74,368)	(\$1,264,256)
250	N/A	N/A	\$11,425	\$6,294	(\$5,131)	(\$87,227)	(\$143,668)	(\$2,442,356)
500	N/A	N/A	\$15,550	\$6,294	(\$9,256)	(\$157,352)	(\$74,048)	(\$1,258,816)
				Average	(\$4,124)	(\$70,100)	(\$78,434)	(\$1,333,378)

Another important factor to consider is the average useful life of the equipment. Based on historical auction figures for the 0 to 125hp motor grader class, MDOT estimates an average useful life of 32 years. The high acquisition costs, relatively low usage, and the age of the fleet make the 0 to 125hp motor grader class a strong candidate for a rent/lease option in the future. We recommend that MDOT consider renting some—or all—of the 0 to 125hp motor graders as the current fleet comes due for replacement.

Exhibit 3 and Exhibit 4 detail the results of our benefit-cost analysis on the 126+hp motor grader equipment class.

**Exhibit 3: Daily, Weekly, and Monthly Rental Options Motor Grader (126+hp)**

Daily, Weekly, and Monthly Rental Options Motor Grader (126+hp)								
Miles to Vendor	Rental Price per Day	Rental Price per Week	Rental Price per Month	Annual Total Ownership Costs	Annual Savings per Unit	Annual Savings to Current Fleet Size (58 units)	Life cycle Cost Savings per Unit (9 years)	Life cycle Cost Savings to Current Fleet Size (58 units)
25	\$1,240	\$2,769	\$7,049	\$20,139	\$13,090	\$759,234	\$117,812	\$6,833,103
50	\$1,296	\$2,825	\$7,105	\$20,139	\$13,034	\$755,989	\$117,309	\$6,803,904
100	\$1,664	\$3,193	\$7,473	\$20,139	\$12,666	\$734,638	\$113,996	\$6,611,743
250	\$2,900	\$4,429	\$8,708	\$20,139	\$11,431	\$662,972	\$102,875	\$5,966,746
500	\$4,959	\$6,488	\$10,768	\$20,139	\$9,371	\$543,528	\$84,341	\$4,891,753
			\$8,221	Average	\$11,918	\$691,272	\$107,266	\$6,221,450

Note: Previous 2 FY average annual usage of 188 hours, or approximately 24 (8) hour days. Average life-to-date annual usage of 280 hours, or approximately 35 (8) hour days. All figures shown are statewide averages.

**Exhibit 4: Two Month Rental Option Motor Grader (126+hp)**

Two Month Rental Option Motor Grader (126+hp)								
Miles to Vendor	Rental Price per Day	Rental Price per Week	Two Month Rental	Annual Total Ownership Costs	Annual Savings per Unit	Annual Savings to Current Fleet Size (58 units)	Life cycle Cost Savings per Unit (9 years)	Life cycle Cost Savings to Current Fleet Size (58 units)
25	N/A	N/A	\$14,098	\$20,139	\$6,041	\$350,405	\$54,373	\$3,153,649
50	N/A	N/A	\$14,209	\$20,139	\$5,930	\$343,917	\$53,366	\$3,095,250
100	N/A	N/A	\$14,946	\$20,139	\$5,193	\$301,214	\$46,740	\$2,710,927
250	N/A	N/A	\$17,417	\$20,139	\$2,722	\$157,882	\$24,499	\$1,420,935
500	N/A	N/A	\$21,536	\$20,139	(\$1,397)	(\$81,006)	(\$12,570)	(\$729,053)

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				Average	\$3,698	\$214,482	\$33,282	\$1,930,342
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Note: The average age of the 126+hp motor grader fleet is 9 years. MDOT estimates an average useful life of 32 years. The age of the fleet skews the average total ownership costs because the acquisition costs are only distributed over nine years. All figures shown are statewide averages.

The relatively low average age of the 126+hp motor grader fleet (9 years) skews the total ownership costs upward because the acquisition costs are only distributed over 9 years. To account for this skew, DMG identified the 21 oldest motor graders in the 126+hp class. These twenty-one motor graders are at least twelve years old, and the oldest is thirty-one years old. We then analyzed the total costs of ownership versus the estimated rental rates of the twenty-one oldest in the fleet. Based on a single month rental option, we estimate an average annual savings of \$3,528 per unit and an average life cycle cost savings of \$63,513 per unit. Exhibit 5 and Exhibit 6 detail the results of this analysis.

#### Exhibit 5: Daily, Weekly, and Monthly Rental Options Motor Grader (126+hp) 21 Oldest in Fleet

Daily, Weekly, and Monthly Rental Options Motor Grader (126+hp) 21 Oldest in Fleet								
Miles to Vendor	Rental Price per Day	Rental Price per Week	Rental Price per Month	Annual Total Ownership Costs	Annual Savings per Unit	Annual Savings to Current Fleet Size (21 units)	Life cycle Cost Savings per Unit (18 years)	Life cycle Cost Savings to Current Fleet Size (21 units)
25	\$1,240	\$2,769	\$7,049	\$11,749	\$4,700	\$98,705	\$84,604	\$1,776,689
50	\$1,296	\$2,825	\$7,105	\$11,749	\$4,644	\$97,530	\$83,597	\$1,755,545
100	\$1,664	\$3,193	\$7,473	\$11,749	\$4,276	\$89,800	\$76,971	\$1,616,394
250	\$2,900	\$4,429	\$8,708	\$11,749	\$3,041	\$63,852	\$54,730	\$1,149,327
500	\$4,959	\$6,488	\$10,768	\$11,749	\$981	\$20,605	\$17,661	\$370,884
				Average	\$3,528	\$74,098	\$63,513	\$1,333,768

Note: Previous 2 FY average annual usage of 148 hours, or approximately 19 (8) hour days. Average life-to-date annual usage of 278 hours, or approximately 35 (8) hour days. All figures shown are statewide averages.

### Exhibit 6: Two Month Rental Option Motor Grader (126+hp) 21 Oldest in Fleet

Two Month Rental Option Motor Grader (126+hp) 21 Oldest in Fleet								
Miles to Vendor	Rental Price per Day	Rental Price per Week	Two Month Rental	Yearly Average Total Ownership Costs	Annual Savings per Unit	Annual Savings to Current Fleet Size (21 units)	Life cycle Cost Savings per Unit (18 years)	Life cycle Cost Savings to Current Fleet Size (21 units)
25	N/A	N/A	\$14,098	\$11,749	(\$2,349)	(\$49,319)	(\$42,274)	(\$887,744)
50	N/A	N/A	\$14,209	\$11,749	(\$2,460)	(\$51,668)	(\$44,287)	(\$930,032)
100	N/A	N/A	\$14,946	\$11,749	(\$3,197)	(\$67,130)	(\$57,540)	(\$1,208,335)
250	N/A	N/A	\$17,417	\$11,749	(\$5,668)	(\$119,026)	(\$102,022)	(\$2,142,467)
500	N/A	N/A	\$21,536	\$11,749	(\$9,787)	(\$205,520)	(\$176,160)	(\$3,699,355)
				Average	(\$4,692)	(\$98,533)	(\$84,457)	(\$1,773,587)

Note: The average age of the 21 oldest 126+hp motor graders in the fleet is 18 years. MDOT estimates an average useful life of thirty-two years. All figures shown are statewide averages.

As the older motor graders in the 126+hp class come to the ends of their useful lives, we recommend that MDOT perform a benefit-cost analysis at the district level in order to identify potential rental/lease opportunities. Again, we recommend that MDOT request long-term rental/lease quotes to optimize efficiencies.

## B. Bulldozers

Bulldozers offer another opportunity for cost savings. Each of the three minor classes of bulldozer could potentially supplement rental options with agency-owned equipment to reduce life cycle cost expenditures.

DMG performed a benefit-cost analysis on the bulldozer equipment class, and the following summarizes the results for 0 to 75hp class. The equipment class has a life-to-date average annual

usage of 406 hours, or approximately 51 (8) hour workdays. The previous 2 fiscal years of usage data indicate an average annual usage of 292 hours, or approximately 37 (8) hour workdays. We calculated an average total cost of ownership of \$11,801 per year.

Based on the rental contract quotes that MDOT provided, we calculated that a statewide average rental rate for a similar class bulldozer is \$4,962 per month. This number includes average round-trip delivery charges at several distances from the vendor (25, 50, 100, 250, and 500 miles). As with the motor grader example, the distance from the vendor strongly affects the benefit-cost result. Average monthly rental agreements for the 0 to 75hp bulldozer class range from \$3,877 for a district located within 25 miles of the vendor, to \$7,280 for a district located 500 miles from the vendor. We used a two month rental option to estimate an average life cycle cost savings of \$16,898 per unit. Exhibit 7 and Exhibit 8 detail the results of this analysis.

### Exhibit 7: Daily, Weekly, and Monthly Rental Options Bulldozers 0 to 75hp

Daily, Weekly, and Monthly Rental Options Bulldozers 0 to 75hp								
Miles to Vendor	Rental Price per Day	Rental Price per Week	Rental Price per Month	Annual Total Ownership Costs	Annual Savings per Unit	Annual Savings to Current Fleet Size (23 units)	Life cycle Cost Savings per Unit (9 years)	Life cycle Cost Savings to Current Fleet Size (23 units)
25	\$784	\$1,560	\$3,877	\$11,801	\$7,924	\$182,254	\$71,317	\$1,640,289
50	\$861	\$1,637	\$3,954	\$11,801	\$7,847	\$180,483	\$70,624	\$1,624,350
100	\$1,195	\$1,971	\$4,288	\$11,801	\$7,513	\$172,801	\$67,618	\$1,555,212
250	\$2,317	\$3,093	\$5,410	\$11,801	\$6,391	\$146,995	\$57,520	\$1,322,958
500	\$4,187	\$4,963	\$7,280	\$11,801	\$4,521	\$103,985	\$40,690	\$935,868
			\$4,962	Average	\$6,839	\$157,304	\$61,554	\$1,415,735

Note: Previous 2 FY average annual usage of 292 hours, or approximately 37 (8) hour days. Average life-to-date annual usage of 406 hours, or approximately 51 (8) hour days. All figures shown are statewide averages.

**Exhibit 8: Two Month Rental Option Bulldozers 0 to 75hp**

Two Month Rental Option Bulldozers 0 to 75hp								
Miles to Vendor	Rental Price per Day	Rental Price per Week	Two Month Rental	Annual Total Ownership Costs	Annual Savings per Unit	Annual Savings to Current Fleet Size (23 units)	Lifecycle Cost Savings per Unit (9 years)	Lifecycle Cost Savings to Current Fleet Size (23 units)
25	N/A	N/A	\$7,754	\$11,801	\$4,047	\$93,086	\$36,425	\$837,770
50	N/A	N/A	\$7,908	\$11,801	\$3,893	\$89,544	\$35,039	\$805,892
100	N/A	N/A	\$8,576	\$11,801	\$3,225	\$74,180	\$29,027	\$667,616
250	N/A	N/A	\$10,820	\$11,801	\$981	\$22,568	\$8,831	\$203,108
500	N/A	N/A	\$14,560	\$11,801	(\$2,759)	(\$63,452)	(\$24,829)	(\$571,072)
				Average	\$1,878	\$43,185	\$16,898	\$388,663

More refined scheduling of maintenance activities and equipment could allow MDOT to supplement its agency-owned bulldozers with rental equipment. There are currently 23 bulldozers in the 0 to 75hp class that are 9 years old, on average. MDOT estimates an average useful life of twelve years. Given the recent data on average annual usage, the estimated new equipment acquisition costs of nearly \$97,000, the currently available rental options, and the average age of the fleet, we recommend that MDOT consider supplementing its agency-owned 0 to 75hp bulldozers with rental equipment as the current fleet is phased out.

The 76 to 125hp class also offers an opportunity for life cycle cost savings. The equipment class has a life-to-date average annual usage of 554 hours, or approximately 69 (8) hour workdays. The previous 2 fiscal years of usage data indicate an average annual usage of 405 hours, or approximately 51 (8) hour workdays. We calculated an average total cost of ownership of \$18,696 per year. Based on the rental contract quotes that MDOT provided, we calculated that a statewide average rental rate for a similar class bulldozer is \$5,590 per month. This number includes average round-trip delivery charges at several distances from the vendor (25, 50, 100, 250, and 500 miles). We used the three month rental option to estimate an average life cycle cost savings of nearly \$27,000 per unit. Exhibit 9 and Exhibit 10 detail the results of the analysis.

**Exhibit 9: Daily, Weekly, and Monthly Rental Options Bulldozers 76 to 125hp**

Daily, Weekly, and Monthly Rental Options Bulldozers 76 to 125hp								
Miles to Vendor	Rental Price per Day	Rental Price per Week	Rental Price per Month	Annual Total Ownership Costs	Annual Savings per Unit	Annual Savings to Current Fleet Size (13 units)	Life cycle Cost Savings per Unit (14 years)	Life cycle Cost Savings to Current Fleet Size (13 units)
25	\$854	\$1,808	\$4,576	\$18,696	\$14,120	\$183,562	\$197,682	\$2,569,870
50	\$964	\$1,918	\$4,686	\$18,696	\$14,010	\$182,129	\$196,139	\$2,549,812
100	\$1,301	\$2,255	\$5,023	\$18,696	\$13,673	\$177,747	\$191,420	\$2,488,463
250	\$2,287	\$3,241	\$6,009	\$18,696	\$12,687	\$164,926	\$177,613	\$2,308,966
500	\$3,931	\$4,885	\$7,653	\$18,696	\$11,043	\$143,557	\$154,600	\$2,009,803
			\$5,590	Average	\$13,107	\$170,385	\$183,491	\$2,385,383

Note: Previous 2 FY average annual usage of 405 hours, or approximately 51 (8) hour days. Average life-to-date annual usage of 554 hours, or approximately 69 (8) hour days. All figures shown are statewide averages.

**Exhibit 10: Three Month Rental Option Bulldozers 76 to 125hp**

Three Month Rental Option Bulldozers 76 to 125hp								
Miles to Vendor	Rental Price per Day	Rental Price per Week	Three Month Rental	Annual Total Ownership Costs	Annual Savings per Unit	Annual Savings to Current Fleet Size (13 units)	Life cycle Cost Savings per Unit (14 years)	Life cycle Cost Savings to Current Fleet Size (13 units)
25	N/A	N/A	\$13,728	\$18,696	\$4,969	\$64,591	\$69,559	\$904,267
50	N/A	N/A	\$14,058	\$18,696	\$4,638	\$60,292	\$64,930	\$844,093
100	N/A	N/A	\$15,069	\$18,696	\$3,627	\$47,146	\$50,773	\$660,046
250	N/A	N/A	\$18,028	\$18,696	\$668	\$8,682	\$9,350	\$121,553
500	N/A	N/A	\$22,959	\$18,696	(\$4,263)	(\$55,424)	(\$59,687)	(\$775,934)

			\$16,769	Average	\$1,928	\$25,058	\$26,985	\$350,805
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The 126+hp bulldozer class also offers an opportunity for cost savings. The equipment class has a life-to-date average annual usage of 451 hours, or approximately 56 (8) hour workdays. The previous 2 fiscal years of usage data indicate an average annual usage of 296 hours, or approximately 37 (8) hour workdays. We calculated an average total cost of ownership of \$19,996 per year. Based on the rental contract quotes that MDOT provided, we calculated that a statewide average rental rate for a similar class bulldozer is \$9,267 per month. This number includes average round-trip delivery charges at several distances from the vendor (25, 50, 100, 250, and 500 miles). We used the two month rental option estimate an average life cycle cost savings of nearly \$22,000 per unit. Exhibit 11 and Exhibit 12 detail the results of the analysis.

### Exhibit 11: Daily, Weekly, and Monthly Rental Options Bulldozers 126+hp

Daily, Weekly, and Monthly Rental Options Bulldozers 126+hp								
Miles to Vendor	Rental Price per Day	Rental Price per Week	Rental Price per Month	Annual Total Ownership Costs	Annual Savings per Unit	Annual Savings to Current Fleet Size (13 units)	Life cycle Cost Savings per Unit (14 years)	Life cycle Cost Savings to Current Fleet Size (13 units)
25	\$1,486	\$3,100	\$8,167	\$19,996	\$11,829	\$35,488	\$177,440	\$532,320
50	\$1,486	\$3,100	\$8,167	\$19,996	\$11,829	\$35,488	\$177,440	\$532,320
100	\$1,852	\$3,467	\$8,533	\$19,996	\$11,463	\$34,388	\$171,940	\$515,820
250	\$3,052	\$4,667	\$9,733	\$19,996	\$10,263	\$30,788	\$153,940	\$461,820
500	\$5,052	\$6,667	\$11,733	\$19,996	\$8,263	\$24,788	\$123,940	\$371,820
			\$9,267	Average	\$10,729	\$32,188	\$160,940	\$482,820

Note: Previous 2 FY average annual usage of 451 hours, or approximately 56 (8) hour days. Average life-to-date annual usage of 296 hours, or approximately 37 (8) hour days. All figures shown are statewide averages.

### Exhibit 12: Two Month Rental Option Bulldozers 126+hp

Two Month Rental Option Bulldozers 126+hp								
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Miles to Vendor	Rental Price per Day	Rental Price per Week	Two Month Rental	Annual Total Ownership Costs	Annual Savings per Unit	Annual Savings to Current Fleet Size (13 units)	Life cycle Cost Savings per Unit (14 years)	Life cycle Cost Savings to Current Fleet Size (13 units)
25	N/A	N/A	\$16,333	\$19,996	\$3,663	\$10,988	\$54,940	\$164,820
50	N/A	N/A	\$16,333	\$19,996	\$3,663	\$10,988	\$54,940	\$164,820
100	N/A	N/A	\$17,067	\$19,996	\$2,929	\$8,788	\$43,940	\$131,820
250	N/A	N/A	\$19,467	\$19,996	\$529	\$1,588	\$7,940	\$23,820
500	N/A	N/A	\$23,467	\$19,996	(\$3,471)	(\$10,412)	(\$52,060)	(\$156,180)
			\$18,533	Average	\$1,463	\$4,388	\$21,940	\$65,820

Rental options, like the other examples, can supplement the current MDOT-owned bulldozer class. This supplementation would allow MDOT access to the necessary equipment and allow it to realize cost savings over the estimated useful life of the equipment class. MDOT should maintain a minimum number of the class and supplement with rental options, wherever possible.

## VII. Benefit-Cost Analysis Conclusions



Rental/lease agreements can efficiently supplement the MDOT-owned equipment fleet. The effective implementation of rental/lease agreements will require maintenance activities to be efficiently scheduled throughout the year, which will require close coordination between maintenance and equipment superintendents. MDOT should develop work schedules and rental agreements in concert in order to ensure that necessary equipment is available when work will be performed.

Currently, MDOT's districts do not share much equipment between one another. We recommend that MDOT promote equipment sharing in order to save costs. Equipment sharing allows districts access to the necessary equipment without purchasing or renting the equipment. To ensure that districts effectively share equipment, equipment managers will need to formally coordinate work and equipment schedules with other counties or districts.

The development and monitoring of utilization standards and the completion of the benefit-cost analysis will inform the rent/lease versus buy decision. Older equipment with high acquisition costs and low usage rates should be considered viable candidates for rental agreements; the 0 to 125hp motor grader class is a good example. An aging fleet with relatively high acquisition costs and relatively low usage rates provide an excellent opportunity for rental agreements. We recommend that MDOT conduct a benefit-cost analysis on each equipment class at the district level in order to identify those pieces of equipment that should be retired/sold and supplemented with rental agreements.

There are several key factors to consider when making the rent/lease versus buy decision. As noted previously, it is essential that maintenance activities and equipment are efficiently scheduled. Additionally, distance from the equipment vendor will strongly influence the benefit-cost analysis results. DMG used statewide averages in our analysis but we recommend that the benefit-cost analysis process be performed at the district level in order to more accurately determine the benefits and/or costs of the rent/lease buy replacement decision. Each district should run its own analysis, based on their relative distance to the available vendors and its specific equipment costs.

Lastly, we recommend that MDOT request quotes for long-term equipment rental/lease options in order to reduce the rental rates and maximize the cost savings. These long-term rental/lease options should include requests for those pieces of equipment for which MDOT does not currently have quotes (e.g., draglines, pickups, and dump trucks). Again, it is important that MDOT maintain a minimum inventory of key equipment for emergency response.

## VIII. High Level Findings and Final Recommendations



Exhibit 13 summarizes the current challenges, recommendations, and potential benefits that DMG has identified for MDOT's Asset Management Division in relation to equipment management practices. DMG presented these findings to the MDOT project team in September 2013 in order to obtain feedback and suggestions.

**Exhibit 13: Current Challenges, Recommendations, and Potential Benefits**

Challenges	Recommendations	Potential Benefits
<b>Optimum Fleet Utilization Rates</b>		
MDOT does not fully incorporate utilization rates into repair-replace- retire decisions  May be underutilized equipment in the MDOT fleet	Develop formal utilization standards and review process  Retire or reassign underutilized equipment to a motor/heavy equipment pool  Consider rental option for specialized equipment that is underutilized	Enable MDOT to retire/reassign underutilized equipment  Can minimize impact on LOS when equipment is retired
<b>Fleet Leasing and Rental</b>		

Challenges	Recommendations	Potential Benefits
<p>MDOT crews may not have access to appropriate type/quantity of equipment to efficiently and effectively perform their work</p> <p>MDOT does not often utilize fleet leasing options</p>	<p>Develop policy/program to encourage leasing of vehicles and equipment; focus on key equipment classes first</p> <p>Consider contracting for comprehensive fleet management services to include vehicle leasing, fuel, maintenance, accident and collision coverage, subrogation, and data management</p> <p>Investigate rental and short-term lease agreements for emergency response and seasonal equipment</p> <p>Request long-term rental/lease quotes from vendors</p>	<p>Will help MDOT streamline their fleet and provide access to necessary and appropriate type/quantity of equipment</p> <p>A means of providing vehicles without direct capital investment</p> <p>Stabilizes cash flow requirements</p> <p>Optimizes depreciation management</p> <p>Administrative efficiencies</p>
<p><b>Optimum Fleet Replacement Schedules through LCCA</b></p>		
<p>MDOT may be using equipment beyond its optimum useful life</p>	<p>Incorporate LCCA into the equipment replacement schedules by identifying the useful life for each key asset class</p>	<p>Minimize life cycle costs of the fleet</p> <p>Identify equipment with high life cycle costs, which can enable MDOT to phase out this equipment and replace with lower life cycle cost equipment</p> <p>Maximize resale value at auction</p>
<p><b>GPS Implementation</b></p>		

Challenges	Recommendations	Potential Benefits
MDOT does not currently utilize GPS or automatic vehicle location (AVL) technology	<p>Develop pilot project to test the effectiveness of GPS implementation</p> <p>Install GPS units to monitor vehicle/equipment location</p>	<p>Reduced labor, equipment, and material costs</p> <p>Reduced fuel usage</p> <p>Better data on vehicle operations</p> <p>Improved tracking for emergency response</p> <p>Possible reduced tort liability</p>
<b>Centralized Fleet Management and Purchasing and Rental</b>		
Limited flexibility for new vehicle/equipment purchases versus repairing old equipment	<p>Centralize vehicle/equipment ownership and purchasing authority</p> <p>Establish program to rent equipment to district</p> <p>Partner with other state and local agencies on equipment procurement</p>	<p>Increased efficiency through new equipment purchases versus repairing old equipment</p> <p>Streamlined procurement process</p> <p>Encourages divisions to more fully utilize equipment</p> <p>Increased purchasing power results in lower prices</p>
<b>Best Value versus Low-bid Procurement Processes</b>		
MDOT utilizes a low-bid procurement process	Develop best value procurement process	Minimizes fleet life cycle costs
<b>Fleet Auctions</b>		

Challenges	Recommendations	Potential Benefits
Maximize fleet auction revenues	Centralize and contract all auction services  Conduct both on-site and online fleet auctions  Ensure fuel cells are near-empty at auction	Broadened auction clientele base  Increased fleet auction revenues  Benefits to local economy
<b>Alternative Fuels and Fuel Quality</b>		
Reduce fuel usage and expenditures	Monitor fuel quality  Increase utilization of alternative fuels	Improved fuel quality  Increased vehicle performance and fuel mileage  Less damage to vehicles and equipment fuel components

The following outlines our final recommendations for updating the MDOT equipment management process. We have organized the recommendations according to the results of our industry best practices research and gap analysis of current MDOT equipment management processes.

## **A. Establish Optimum Fleet Utilization and Replacement Schedules**

Currently, MDOT uses replacement schedules that utilize equipment beyond its optimum useful life and reduce the return at auction. In the short-term, we recommend that MDOT develop standard utilization rates for its equipment in order to monitor equipment usage. MDOT can use these rates to identify under-utilized equipment and either retire or reassign that equipment, which will streamline the fleet. This process is detailed in a subsequent section. Additionally, we recommend that MDOT analyze historical maintenance and operating costs to minimize equipment life cycle costs and to maximize resale prices at auction.

In the long-term, we recommend that MDOT investigate the feasibility of developing a system similar to ALDOT's CEMS. While there are costs associated with the development of such a system, the result is that MDOT would be able to modernize its equipment management processes to quickly realize additional efficiencies.

We recommend that MDOT perform a feasibility study before implementing such a system to help quantify the return on investment. Possible solutions include commercial off-the-shelf (COTS) systems or in-house development of the system. COTS solutions typically offer low development costs and quick deployment of the software, relative to in-house development. In-house development offers high customization and quick access to IT services, including custom report development and issue resolution.

## **B. Encourage Fleet Leasing and Rental Options**

Currently, MDOT may not have access to the appropriate types and quantities of equipment necessary to effectively and efficiently perform its work. Mark Holley, District Engineer for district one, conducted an analysis on the effect of fleet reduction on daily maintenance operations. A specific example from Mr. Holley's analysis came from November 2012 in Lowndes County. In this example, two separate crews performed drainage maintenance and sign maintenance, respectively. The limited number of pickups in the county necessitated that the sign maintenance crew use a seven cubic yard dump truck in their operations when a pickup would have been sufficient. The increased operating costs of the dump truck resulted in approximately \$20 of unnecessary expenditures per day. Mr. Holley estimates that this situation occurs on an average of three times per week in the county. This scenario results in approximately \$3,000 in unnecessary expenditures per year at the county level. These funds could be put towards rental/lease equipment that would provide the county with the necessary equipment and reduce unnecessary wear and tear on the dump truck.

MDOT does not often utilize rental and/or leasing options. We recommend that MDOT develop a policy/program to encourage increased vehicle and equipment rental and/or leasing. Increased leasing can reduce the fleet size and lower the life cycle costs of the fleet while maintaining access to necessary vehicles and equipment. DMG conducted a high-level benefit-cost analysis of the rent/lease versus buy decision and made suggestions in the benefit-cost analysis results summary section of this report. However, MDOT should conduct a more detailed rent/lease versus buy analysis to validate the potential benefits from increased rent/leasing options. Rental and short-term agreements may be especially useful for emergency response, seasonal usage, and specialty equipment. Current rental rates are quoted as day, week, and monthly rates. We recommend that MDOT request quotes for long-term equipment rental/lease options in order to reduce the rental rates and maximize cost savings.

## **C. Utilize GPS**

MDOT considered GPS implementation in the past, but at the time found it cost prohibitive. Since then, the technology has improved and costs have decreased. We recommend that MDOT

continue to pursue a pilot project to test the effectiveness of GPS implementation. Benefits could include increased worker productivity, decreased fuel usage, and reduced tort liability. The GPS data could also serve as a supplement to, or check on, MDOT EMS usage data, which would enable MDOT to closely monitor utilization rates and identify equipment for retirement or reallocation. Life-to-date historical usage data for half ton gasoline pickup trucks indicate an average annual usage of approximately 16,000 miles. MDOT computes a cost of \$0.23 per mile, or \$3,680 per year. A 5 percent reduction in miles driven would result in an average annual savings of \$760 per unit. There are currently 615 half ton gasoline pickup trucks in the fleet, which would net a statewide average annual savings of over \$467,000.

A pilot in a single district will enable MDOT to determine if statewide GPS implementation is warranted. MDOT should look to other agency implementations, as noted earlier in this report, for guidance on effective implementation. DMG contacted GPS vendor Networkfleet and discussed our recommendations with MDOT regarding a pilot of GPS on vehicles and equipment. The management of end-user perception is an important component to successful GPS implementation. If MDOT wishes to pursue the GPS pilot, we recommend that MDOT install GPS units in management vehicles as well as in work crew equipment to help champion the effort and demonstrate a commitment to the technology.

## **D. Implement Centralized Equipment/Fleet Equipment Management and Purchasing**

Currently, MDOT disperses equipment management and procurement authority to district equipment supervisors. However, those purchasers are sometimes limited in their ability to purchase new vehicles. We received reports from MDOT supervisors who, due to limited spending options, feel “forced” to invest substantial funds in equipment repairs, rather than purchase new equipment. Such investment may occur even when the repair costs outweigh the value of the equipment.

In the short-term, we recommend that MDOT modify spending policies to grant supervisors discretion in the utilization of their equipment budgets. Increasing the flexibility in new vehicle and equipment purchasing should promote efficient repair-replace-retire decisions because it will enable equipment supervisors to procure new rather than repair old equipment, which may not be cost effective.

We also recommend that MDOT continue to set deadlines for equipment requisitions so that like items can be advertised together. The increased volume of purchases should result in lower purchase prices. Additionally, we recommend that MDOT consider developing partnerships with

other state and local agencies (e.g., ALDOT) to further increase the purchasing power of the agencies.

In the long-term, we recommend that MDOT investigate the feasibility of a centralized equipment management and procurement system. While a centralized equipment management and purchasing system represents a departure from current MDOT processes, the benefits of streamlined operations and large-scale equipment purchases will likely reduce costs and increase agency efficiency.

## **E. Implement Best-Value versus Low-bid Procurement Processes**

Currently, MDOT employs a low-bid procurement process. While this process does minimize the original purchase cost, it does not necessarily minimize fleet life cycle costs. We recommend that MDOT move toward a best value procurement process to include considerations such as life cycle maintenance costs, distance of equipment maintenance facilities from division offices, and vendor maintenance warranties. We understand that such a process may require legislative and/or executive approval and we recommend that MDOT investigate the approval process.

## **F. Conduct Centralized Onsite and Online Fleet Auctions**

Currently, MDOT utilizes both in-house and contracted fleet auction services. The in-house auctions are conducted on-site, where each district hires the auctioneer. The Asset Management Division administers the auction with help from the district. Also, MDOT contracts an auction services company for sales of large equipment and specialized vehicles. This company generally utilizes online auction services, which has the benefit of international bidding and a larger group of potential buyers.

We recommend that MDOT centralize all auction service contracts and include provisions for online auction services in each contract. This centralization will enable MDOT broaden clientele base to increase fleet auction revenues. Additionally, we recommend that MDOT use local providers to contract maintenance and equipment preparation, which other DOTs have demonstrated as effective. This local contracting will free MDOT staff time and benefit the local economy.

## **G. Monitor Fuel Quality and Utilize Alternative Fuels**

We recommend that MDOT continue to utilize alternative fuel options and monitor fuel quality. Agencies like ALDOT contract with a fuel testing center to monitor the quality of its fuels and we recommend that MDOT consider a similar approach. We also recommend that MDOT monitor the fuel mileage and operating costs of its current alternative fuel fleet in order to evaluate the potential for increased utilization of alternative fuels.



## IX. Implementation Strategy



**Exhibit 14: Implementation Strategy Details**

<b>Recommendation</b>	<b>Steps Necessary</b>	<b>Challenges/ Risks</b>	<b>Mitigation Strategy</b>	<b>Estimated Task Duration</b>
<b>Establish Optimum Fleet Utilization and Replacement Schedules</b>	Perform the process described for establishing optimum fleet utilization standards	Preferable to have more than two years of usage data when calculating the minimum usage standards	Continue to update minimum usage standards as data inputs improve	Ninety days initially, thirty days annually
	Conduct workshop with executive staff and select equipment supervisors to develop minimum equipment utilization rates		Schedule cyclical workshops to review the utilization standards	
Develop agency memo that describes the reason and results of the process	Resistance from district equipment superintendents	Clearly communicate the process and potential benefits		
		Executive staff should champion the effort and show support for the updated processes		
			Identify district champions to increase buy-in	
			Effective change management will be critical	
<b>Encourage Fleet Leasing and Rental Options</b>	Request long-term rental/lease quotes from potential vendors	Resistance from district equipment superintendents	Clearly communicate the process and potential benefits	Thirty days
	Conduct benefit-cost analysis on major and minor		Develop presentation to detail the benefit-cost analysis results to districts	

Recommendation	Steps Necessary	Challenges/ Risks	Mitigation Strategy	Estimated Task Duration
	<p>equipment classes to identify opportunities for efficiencies through rental/lease agreements</p> <p>Develop agency memo to alert equipment supervisors of the policy and note the 10 percent threshold that DMG recommends</p> <p>Pilot a program to share equipment between two districts to determine efficiency and analyze level of utilization by superintendents</p>	<p>No access to necessary equipment during emergencies</p>	<p>Ensure a minimum of state-owned, essential equipment to mobilize in the event of an emergency</p> <p>May require a workshop with executive staff and equipment/maintenance superintendents to identify equipment essential in emergency response</p>	<p>Thirty days</p>
	<p>Pilot a program to share equipment between two districts to determine efficiency and analyze level of utilization by superintendents</p>	<p>Lack of coordination between maintenance and equipment supervisors can cause scheduling conflicts and inefficiencies</p>	<p>Conduct onsite or web-based tutorials or workshops about how to efficiently and effectively schedule work and equipment in advance</p> <p>Identify districts, if any, currently engaged in equipment sharing to obtain feedback and guidance</p> <p>Identify other states that regularly engage in coordinated equipment rentals and/or equipment sharing for guidance</p>	<p>Thirty days</p>

Recommendation	Steps Necessary	Challenges/ Risks	Mitigation Strategy	Estimated Task Duration
<b>Utilize GPS</b>	<p>Continue to work with Networkfleet (and other vendors, if necessary) to investigate options</p> <p>Conduct workshop with district representatives to determine the GPS functionality, extent/quantity of deployment, reporting capabilities, et cetera desired for the pilot project</p> <p>Identify potential pilot districts</p> <p>Conduct a pilot project in single district</p> <p>Analyze results from pilot district and determine if statewide implementation is feasible</p>	Managing end-user perception	<p>Executive and management staff should champion the effort, install GPS units in their state vehicles as well</p> <p>The workshop involving district representatives should increase buy-in and reduce resistance; identify champions at the district level and keep them involved during the process</p> <p>Clearly communicate the benefits of GPS implementation to both the state and individual district equipment budgets. (e.g., fuel savings provide more money for new equipment, repairs, et cetera)</p> <p>Using examples of successful implementations (e.g., AHTD, ALDOT, et cetera) to develop communication materials</p>	Thirty days to prepare for pilot; thirty days to conduct pilot; thirty days to report results and determine feasibility for statewide implementation
		Liability and legality issues that surround GPS implementation	<p>Work with GPS vendor to develop the necessary legal and human resources materials to protect the agency</p> <p>Look to other public agencies experienced with GPS implementation for guidance on how to mitigate the risks and maximize benefits</p>	Sixty days

Recommendation	Steps Necessary	Challenges/ Risks	Mitigation Strategy	Estimated Task Duration
<b>Conduct Centralized Onsite and Online Fleet Auctions</b>	<p>Investigate auction companies to organize and run the sale</p> <p>Develop team of district representatives experienced with fleet auctions to assist and support the process</p>	Auction participants may not be aware of the updated auction	Develop press release and/or notice for past auction participants	Thirty days to research auction options and costs; sixty days to negotiate with selected vendor and launch initial auction
<b>Implement Best-Value Procurement Process</b>	<p>Identify legislative and/or agency requirements, if any, to move to a best-value versus low-bid procurement process</p> <p>Research best-value procurement processes at other agencies and determine the best path for MDOT</p> <p>Conduct workshop to formalize a policy and procedure for a best-value procurement process</p> <p>Develop communication materials to distribute to equipment purchasers</p>	Will require legislative approval	Effective communication with legislators will maximize the potential for acceptance	Ninety days to develop case studies and scenarios where best-value is proven to be more effective; thirty days to develop executive-level presentation

Recommendation	Steps Necessary	Challenges/ Risks	Mitigation Strategy	Estimated Task Duration
<b>Monitor Fuel Quality and Utilize Alternative Fuels</b>	Investigate firms or state agencies that can provide the services	Costs to procure fuel monitoring services may outweigh the benefits	The Mississippi Department of Agriculture and Commerce Regulatory Services Bureau inspects petroleum products throughout the state  Local and/or state universities may be able to provide the services at minimal cost to the agency	Ninety days to review possible services and establish process
<b>Implement Centralized Equipment/Fleet Management and Purchasing</b>	Develop strategy and plan for implementation  Determine which equipment will be managed centrally (e.g., heavy equipment, fleet, et cetera)	Resistance from district equipment superintendents  Updates to equipment management systems and processes	Clearly communicate the benefits of centralized system (e.g. streamlined purchasing/procurement, large purchase orders translate to cost savings, et cetera)  Effective change management will be critical	Sixty days to develop work plan and approach for implementation  TBD, based on possible system updates

## **X. Appendix I: Benefit-Cost Analysis Results**



Major Equipment Class	Minor Equipment Class	Acquisition Costs	Average Annual Total Operating Costs	Resale Value	Average Total Costs of Ownership	Average Annual Total Cost of Ownership	2012-2013 FY Average Annual Usage	Life-to-Date Average Annual Usage	Average Rental Costs (per month)	Average Age of Fleet	Estimated Average Useful Life
Motor Grader	0 to 125hp	\$125,000	\$60,915	\$9,669	\$176,246	\$6,294	145 (hrs)	245 (hrs)	\$5,209	28	32
	126+hp	\$165,000	\$27,097	\$10,845	\$181,252	\$20,139	188 (hrs)	280 (hrs)	\$7,230	9	32
Bulldozer	0 to 75hp	\$96,600	\$26,429	\$20,900	\$102,129	\$11,348	292 (hrs)	406 (hrs)	\$4,962	9	12
	76 to 125hp	\$200,000	\$75,046	\$13,300	\$261,746	\$18,696	405 (hrs)	554 (hrs)	\$5,590	14	23
	126+hp	\$225,000	\$87,054	\$12,113	\$299,941	\$19,996	296 (hrs)	451 (hrs)	\$9,267	15	31
Front End Loader	1CY	\$75,000	\$93,658	N/A	N/A	N/A	298 (hrs)	257 (hrs)	\$5,615	20	N/A
	2CY	\$106,000	\$62,550	\$7,660	\$160,890	\$11,492	246 (hrs)	438 (hrs)	\$5,799	14	24
	3CY	\$175,000	\$80,444	N/A	N/A	N/A	287 (hrs)	382 (hrs)	\$6,782	15	N/A

Dragline	Crawler Mounted	\$200,000	\$47,172	N/A	N/A	N/A	40 (hrs)	104 (hrs)	N/A	28	N/A
	Rubber Tire Mounted	\$500,000	\$81,991	\$3,848	\$578,143	\$26,279	73 (hrs)	305 (hrs)	N/A	22	28
Excavator	0 to 90hp	\$140,000	\$17,933	\$23,985	\$133,948	\$16,743	435 (hrs)	674 (hrs)	\$5,332	8	11
	100 to 144hp	\$175,000	\$80,397	\$10,587	\$244,810	\$20,401	584 (hrs)	554 (hrs)	\$7,473	12	22
	145+hp	\$200,000	\$91,434	N/A	N/A	N/A	441 (hrs)	555 (hrs)	\$7,371	9	N/A
	Carrier Mounted	\$300,000	\$1,351	N/A	N/A	N/A	61 (hrs)	194 (hrs)	N/A	1	N/A
Crane		\$150,000	\$49,106	N/A	N/A	N/A	41 (hrs)	240 (hrs)	N/A	28	N/A
Roller	Powered 0 to 15 ton	\$70,000	\$46,947	\$1,836	\$115,111	\$6,395	96 (hrs)	356 (hrs)	N/A	18	23
	Powered 16+ ton	\$125,000	\$33,248	N/A	N/A	N/A	40 (hrs)	438 (hrs)	N/A	14	N/A
	Pneumatic Tire Pull	\$25,000	N/A	N/A	N/A	N/A	42 (hrs)	70 (hrs)	N/A	16	N/A

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	Type										
	Static Steel 5-11 ton	\$65,000	\$16,866	\$3,462	\$78,404	\$4,127	36 (hrs)	116 (hrs)	N/A	19	30
	Static Steel 12 to 14 ton	\$100,000	\$37,659	N/A	N/A	N/A	214 (hrs)	507 (hrs)	N/A	11	N/A
	Sheepfoot Pull Type	\$20,000	\$1,818	N/A	N/A	N/A	20 (hrs)	99 (hrs)	N/A	29	N/A
	Vibratory 0 to 4 ton	\$40,000	N/A	N/A	N/A	N/A	36 (hrs)	55 (hrs)	N/A	11	N/A
	Vibratory 12 to 14 ton	\$105,000	\$13,520	N/A	N/A	N/A	325 (hrs)	527 (hrs)	N/A	6	N/A
Pickup Truck											
	Gasoline 1/4 ton	\$15,000	N/A	\$2,450	\$35,984	\$3,271	10,394 (mi)	11,597 (mi)	N/A	11	10
	Gasoline 1/2 ton	\$15,000	N/A	\$2,450	\$40,344	\$5,043	14,496 (mi)	16,288 (mi)	N/A	8	10
	Gasoline 3/4 ton	\$15,000	N/A	\$2,450	\$52,237	\$8,706	19,285 (mi)	20,581 (mi)	N/A	6	10
	Alt Fuel 1/4 ton	N/A	N/A	N/A	N/A	N/A	13,030 (mi)	11,283 (mi)	N/A	10	N/A
	Alt Fuel 1/2 ton	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

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	Alt Fuel 3/4 ton	N/A	N/A	N/A	N/A	N/A	19,245 (mi)	25,412 (mi)	N/A	2	N/A
Dump Truck											
	2 to 4 CY	\$32,000	\$30,487	\$3,389	\$93,977	\$13,425	15,040 (mi)	16,509 (mi)	N/A	7	13
	5 to 9 CY	\$75,000	\$33,731	\$4,037	\$133,823	\$9,559	5,491 (mi)	7,347 (mi)	N/A	14	22
	10+ CY	\$90,000	\$35,820	\$5,172	\$160,943	\$20,118	8,508 (mi)	11,852 (mi)	N/A	8	20

## **XI. Appendix II: MDOT Equipment Management Process**

