

ENVIRONMENTAL ASSESSMENT

Commercial Demonstration of the Manufactured Aggregate Processing Technology Utilizing Spray Dryer Ash, King George County, Virginia



**United States Department of Energy
National Energy Technology Laboratory**

August 2002

**National Environmental Policy Act (NEPA) Compliance
Cover Sheet**

Proposed Action:

The proposed action is for the U.S. Department of Energy (DOE) to provide cost-shared financial support to Universal Aggregates, LLC, for the design, construction, and operation of a lightweight aggregate manufacturing plant at the Mirant-Birchwood Power Plant Facility (Mirant-Birchwood Facility) in King George County, Virginia. DOE would provide approximately 37% of the \$19.6 million cost of the project (about \$7.2 million), with the industrial participant providing the remainder of the cost. The project, which includes 15 months of operation and testing, would involve transforming 115,000 tons of spray dryer ash currently generated at the Mirant-Birchwood Facility into 167,000 tons of lightweight aggregate for use in the manufacture of lightweight masonry blocks or lightweight concrete. Based on the results of the demonstration, the funding provided by DOE would be repaid by the industrial participant if the project is successfully commercialized.

Type of Statement: Draft Environmental Assessment

**Lead Agency: U.S. Department of Energy; National Energy Technology
Laboratory**

DOE Contacts:

Project Information:

Mark McKoy/Janice Bell
NEPA Document Managers
U.S. Department of Energy
National Energy Technology Laboratory
P.O. Box 880
Morgantown, WV 26507-0880
304-285-4426; 304-285-4403 (fax)
mark.mckoy@netl.doe.gov (e-mail)
jbell@net.doe.gov (e-mail)

NEPA Information:

Lloyd Lorenzi
NEPA Compliance Officer
U.S. Department of Energy
National Energy Technology Laboratory
P.O. Box 10940
Pittsburgh, PA 15236-0940
412-386-6159; 412-386-4604 (fax)
lorenzi@netl.doe.gov (e-mail)

Abstract:

This Environmental Assessment analyzes the environmental and human impacts that would result from the proposed action, a cooperative agreement between the U.S. Department of Energy (DOE) and Universal Aggregates, LLC, to design, construct, and operate a lightweight aggregate manufacturing plant at the Mirant-Birchwood Power Plant Facility (Mirant-Birchwood Facility), King George County, Virginia. DOE seeks to provide funds to produce and test the lightweight aggregate in support of the Power Plant Improvement Initiative, a program encouraging industry to look at new ways for existing coal-fired power plants to improve the way they operate. Demonstration of lightweight

aggregate technology could help coal-fired plants to avoid premature shutdowns since it would result in a more effective, low-cost pollution control technology.

The 238 MW_{net} Mirant-Birchwood Facility is a cogeneration unit located about 50 miles northeast of Richmond. It produces both power, which is sold to the public, and process steam, which is used to heat local greenhouses. The plant is equipped with a spray dryer to control sulfur dioxide (SO₂) emissions. Universal Aggregates proposes to use the 115,000 tons per year of spray dryer ash currently generated at the facility to produce 167,000 tons per year of lightweight aggregate for use in lightweight masonry blocks and lightweight concrete. The spray dryer ash produced from this unit currently undergoes disposal at an off-site landfill.

The environmental analysis of the proposed action found that the most notable impacts would be an increase in truck traffic and diversion of the waste stream from the nearby landfill. The truck traffic would increase on nearby roadways, both during the construction phase and during the operational phase. Additionally, diversion of the waste stream from the nearby landfill, where it currently serves as daily cover, would result in a loss of \$5/ton in tipping fees for King George County and would necessitate finding an additional source of daily cover. No other significant adverse impacts have been identified. No harm to threatened or endangered species or critical habitats would result. During construction and operation of the facility, fugitive dust, noise and surface water runoff impacts would be negligible, and there would be no significant waste streams from the manufacturing process.

Public Participation:

DOE encourages public participation in the NEPA process. This Draft Environmental Assessment (EA) is being released for public review and comment. The public is invited to provide oral, written, or e-mail comments on this draft Environmental Assessment to DOE by the close of the comment period on **September 16, 2002**. Copies of the draft EA are also being distributed to cognizant Federal and state agencies. Comments received by the close of the comment period will be considered in preparing a final Environmental Assessment for the proposed DOE action.

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LIST OF ACRONYMS

AASHTO	American Association of State Highway and Transportation Officials
ADT	Average Daily Traffic
ASTM	American Society for Testing and Materials
CCA	Clean Air Act
CCB	Coal Combustion Byproducts
CCT	Clean Coal Technology
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
DOE	U.S. Department of Energy
ESA	Environmental Site Assessment
FAA	Federal Aviation Administration
GW	Gigawatt
HAP	Hazardous Air Pollutant
MSDS	Material Safety Data Sheets
MW	Megawatt
NAAQS	National Ambient Air Quality Standards
NAVSWC	Naval Surface Warfare Center
NEPA	National Environmental Policy Act
NWI	National Wetland Inventory
PM₁₀	Particulate Matter less than 10 microns
PSD	Prevention of Significant Deterioration
psi	Pounds per square inch
RCRA	Resource Conservation and Recovery Act
RPA	Resource Protection Area
SDA	Spray-dryer Absorption
TCLP	Toxicity Characteristic Leaching Procedures
VDGIF	Virginia Department of Game and Inland Fisheries

SUMMARY

The U.S. Department of Energy (DOE) proposes to provide funding, through a cooperative agreement with Universal Aggregates, LLC, to demonstrate the manufacture of lightweight aggregate from spray-dryer ash, a byproduct of flue gas desulfurization (FGD), at a commercial level of operation. DOE's share of the \$19.6 million total project cost would be \$7.2 million (37 percent), partially funding the design, construction, and operation of the lightweight aggregate manufacturing plant. The proposed facility would be located at the Mirant-Birchwood Power Plant Facility (Mirant-Birchwood Facility) in King George County, Virginia, approximately 10 miles east southeast of Fredericksburg and 50 miles northeast of Richmond. The project was one of eight projects selected by DOE under the Power Plant Improvement Initiative, a program encouraging existing coal-fired power plants to improve the way they operate. The period of performance is expected to last 30 months.

Once operational, the plant would convert spray-dryer ash from the Mirant-Birchwood Facility into lightweight aggregate, which can be used in a variety of lightweight concrete applications, including structural concrete and masonry blocks. The project involves transforming an estimated 115,000 tons per year of spray-dryer ash into 167,000 tons of lightweight aggregate. The proposed aggregate manufacturing process would offer power generators an alternative to landfilling by converting their waste material into a highly beneficial product. The U.S. market for construction aggregates is currently 2 billion tons annually.

A successful demonstration could also result in the construction of additional lightweight aggregate manufacturing facilities throughout the United States. There are 21 spray-dryer facilities currently operating within the United States that produce an adequate amount of spray-dryer ash to economically justify installation of lightweight aggregate manufacturing facilities. As additional scrubbing of coal-fired power plant flue gas is required, FGD technologies will become the technology of choice for power plants with a capacity of less than 300 MW.

The proposed project site consists of less than 5 acres of land and is located within the property lines of the Mirant-Birchwood Facility. The proposed site was previously disturbed during construction of the power plant. No significant impacts to human health and safety or the environment would be anticipated from construction and operation of the proposed facility.

The proposed facility would utilize all of the spray-dryer ash produced by the Mirant-Birchwood Facility. This ash is currently used by the King George County

Landfill as daily cover material. Therefore, it would be necessary for the landfill to secure other cover material, thus potentially resulting in additional areas being disturbed for soil/sand borrow activities. King George County currently receives \$5 per ton from tipping fees for landfilling of the spray-dryer ash. This income to the county would be lost. Nevertheless, the King George County Planning Commission approved a special exemption and modification of the proffer statement from the Mirant-Birchwood Facility to enable Universal Aggregates LLC, to design, construct, and operate the lightweight manufactured aggregate facility.

The proposed project would create nine manufacturing jobs, as well as additional employment in the local trucking industry for delivery of aggregates to customers and reagents to the facility. Additional environmental benefits from implementation of this technology include a reduction of landfilling of FGD waste and a reduction in the impacts associated with mining materials used to produce expanded clay/shale-based lightweight aggregate.

1.0 BACKGROUND

Currently in the United States, flue gas desulfurization (FGD) technologies are used in many coal-fired power plants, producing more than 20 million tons per year (dry weight) of FGD waste. And, as the requirements of the Clean Air Act (CAA) Amendments of 1990 continue to be phased in, the amount of FGD waste is expected to increase substantially. Presently, the vast majority of these wastes are disposed of in landfills at significant cost to utilities and ultimately to consumers.

As amended, the CAA requires installation of FGD systems to be placed on most coal-burning power plants to reduce sulfur dioxide (SO₂) emissions. However, less than 20 percent of these wastes are currently utilized or recycled, while regulatory pressures on power generators are increasing. The technology proposed for demonstration at the Mirant-Birchwood Facility would convert the spray-dryer ash produced at the plant into high-quality construction aggregate. The process has two primary advantages for power plants: reduced waste management costs and reduced environmental liability.

Most spray-dryer ash is disposed of in landfills. The current practice is to adequately wet the spray-dryer ash to allow for optimum compaction for landfilling and to control dust levels during transport. The damp spray-dryer ash is buried in the landfill where the material gradually hardens into a solidified mass. If a monofill landfill is used, there is a potential to reclaim the materials for low-cost road and structural fills. However, such a landfill would probably be the final repository for this waste due to the low value of such fill material, potential environmental concerns, and the cost of transportation. The cost of landfill disposal for FGD wastes varies greatly by location. Operating and maintenance costs for a landfill are \$2-\$4/ton of as-disposed material. Capital costs, including landfill preparation, are typically between \$8-\$17/ton depending upon the cost of land, construction requirements (i.e., lined versus unlined), geology, and environmental monitoring. For a power plant, being able to avoid disposal costs can greatly reduce power generation costs.

Over the past 10 years, various processes have been developed to utilize FGD wastes. In fact, spray-dryer absorption (SDA) systems, which remove SO₂ from flue gases, have been of particular concern to DOE because these systems can generate large volumes of solid waste. SDA systems inject an "atomized" slurry containing hydrated lime, Ca(OH)₂, into the flue gas stream. The lime reacts with and removes SO₂ from the flue gas. Because of the high temperature of the flue gas at the injection site (270°F to 350°F), moisture quickly evaporates from the slurry, leaving a dry powder comprised of fly ash and calcium sulfite (CaSO₃), plus lesser amounts of

calcium sulfate (CaSO₄), calcium carbonate (CaCO₃), and unreacted lime. Since this is such a high volume byproduct stream, production of a saleable byproduct could significantly reduce power generation costs, minimize landfilling, and make use of an existing waste material. As an example, the consumption of construction aggregates in the United States currently exceeds 2 billion tons per year. By manufacturing low-density, high-strength gravel material, power plants could actually help the construction industry meet its need for aggregate. And, if coal-fired power plants in metropolitan areas are to meet applicable environmental regulations, particularly in terms of SO₂ control, operators need to consider FGD scrubbing, fuel switching, and possibly early retirement of the plant. Use of an SDA system is an option for small generators (<300 MW units) to consider if wastes management costs are acceptable. In addition, production and sale of manufactured aggregates can make this option viable in tightly congested metropolitan areas where landfill costs are high.

With over 17 GW of electrical generating capacity located within U.S. metropolitan areas, many plants are running out of area to dispose of FGD waste. In addition, President Bush recently announced plans to require additional SO₂ and oxides of nitrogen (NO_x) controls on existing power plants. These additional controls may also require additional landfill area that may not be available. Such land disposal issues can then delay compliance schedules, cause coal-fired plants to switch to natural gas, or force premature closures. If "metropolitan" plants switch fuel or are forced into premature closure, greatly reduced generating capacity and decreased reliability of the power grid would result.

Power producers continuing to use coal need to find ways to reduce or eliminate costs associated with waste disposal. Successful demonstration of a lightweight aggregate manufacturing facility could be the answer. There are 21 spray-dryer facilities currently operating within the United States that produce an adequate amount of spray-dryer ash to economically justify installation of additional lightweight aggregate manufacturing facilities. And, as additional scrubbing of flue gas becomes necessary, FGD will become the technology of choice for power plants with a capacity of less than 300 MW.

The byproducts of various FGD processes (spray-dryer absorption, fluidized-bed combustion, and lime and limestone wet-FGD) have the potential to be utilized for manufactured construction aggregates as substitutes for crushed stone, sand, gravel, and conventional lightweight aggregates (expanded shale/clay). Products from pilot demonstrations of the proposed technology have been determined to meet the quality requirements and industry standards as determined by the American

Society for Testing and Materials (ASTM) and the American Association of State Highway and Transportation Officials (AASHTO).

As an example, manufactured aggregates have already been produced using the spray-dryer ash from several facilities. In late 1995 and early 1996, bench-scale equipment was used to produce two test batches (1,200 lbs and 1,700 lbs) of lightweight manufactured aggregates. In late 1999 and late 2000, 44 tons and 25 tons, respectively, of lightweight manufactured aggregates were produced in a continuous 500 lb/hr pilot plant using spray-dryer ash, the latter of which was from the Mirant-Birchwood Facility. Properties of the crushed, cured aggregates from bench-scale testing are presented in Table 1, while Table 2 shows properties of concrete blocks produced using the manufactured aggregates.

Table 1 - Properties of Lightweight Aggregates from Spray-dryer Byproducts					
	SDA Aggregate Batch 1 (1995)	SDA Aggregate Batch 2 (1996)	SDA Aggregate (Pilot Plant Source)	Mirant- Birchwood SDA Aggregate	Lightweight Aggregate Specifications ASTM C-331
Grain Size (Sieve #)	No. 8	Nos. 8/9	Nos. 8/9	Nos. 8/9	No. 8 (Coarse) Nos. 8/9 (Combined)
Dry Unit Wt. lb./ft.³	52.6 -----	----- 55.4	----- 55.8	----- 51.6	55 (max), No. 8 65 (max), Nos. 8/9
Clay Lumps, Wt.%	1.6	1.5	1.1	1.7	2.0 (max)
Staining Material	Negative	Negative	Negative	Negative	Negative
Crush Strength, lb.	90	120	210	187	No Specification

Table 2- Properties of Concrete Blocks Made From Manufactured Aggregates				
				ASTM C-90

	Batch 1 Blocks	Batch 2 Blocks	Batch 3 Blocks	Lt. Wt. Concrete Block Spec.
Dry Unit Wt., lb./ft.³	99.9	100.9	103.0	105 (max)
Water Absorption Wt. %	16.9	16.8	16.9	18 (max)
Net Compressive Strength, psi	2,953	1,930	2,359	1,900 (min)

Each block met the ASTM specification for lightweight concrete masonry units including the unit weight, water absorption, and compressive strength. The results demonstrate that light-weight manufactured aggregates produced using spray-dryer ash could economically be used by commercial block manufactures to replace conventional lightweight aggregates in block mixes.

A third set of tests were initiated in June 2001, when 2.8 tons of cured, extruded products were produced in semi-continuous production runs using bench-scale equipment and materials from the Mirant-Birchwood Facility. Extrusion was used for agglomeration of the uncured product. After curing, the extruded products were crushed and screened for aggregate production. The crushed aggregate was used for concrete block production at a plant in Maryland. Table 3 compares the properties of the blocks produced using the manufactured lightweight aggregate with those produced using conventional lightweight aggregate and with the ASTM C-90 standard for load-bearing concrete masonry units. The components in both block types are lightweight aggregate, sand, limestone, and cement. The amount of lightweight aggregate used in production of the concrete block is less than the amount of conventional lightweight aggregate used in production of concrete block (26.7 percent vs. 28.3 percent, by weight of block aggregate components).

Table 3 - Properties of Manufactured and Commercial Lightweight Aggregate Blocks and ASTM C-90 Specification			
	Manufactured Lightweight Aggregate Block	Commercial Lightweight Aggregate Block	ASTM C-90 Concrete Masonry Units Specifications*
Dry Unit Weight, lb./ft.³	117.9	121.3	125
Water Absorption, lb./ft.³	12.1	10.2	15.0

Compressive Strength, psi	3,140	3,630	1,900
Dry Shrinkage, %	0.036	0.031	0.065

*Medium-weight block.

As shown in Table 3, block produced from the new lightweight aggregate met the ASTM specification for medium-weight concrete masonry units, which is the predominant type used in construction within the potential market area. The market area for manufactured aggregate produced from the Mirant-Birchwood Facility SDA byproduct would be Maryland and Virginia.

In August 2001, 27 tons of cured, extruded products were produced for three different mix designs using the Mirant-Birchwood Facility SDA byproduct in the continuous 500 lb/hr pilot plant. The cured extruded products were crushed and screened for aggregate production. Each mix of the aggregate was able to meet the ASTM C331 lightweight aggregate specification. The water absorption of crushed aggregates (28 – 32 percent, dry weight basis) produced by extrusion is substantially lower than had been produced previously (typically 40 percent absorption, dry weight basis) in pilot plant operation with disk pelletization. Table 4 lists the properties of blocks made from aggregates using three different mix designs (M-1, M-2, and M-3). The same amounts of block components (manufactured lightweight aggregate, sand, limestone, and cement) were used during block manufacturing to facilitate comparison. Also included in Table 4 are the properties of block made with less lightweight aggregate (*Refer to column labeled M-4*).

Table 4 - Properties of Blocks Made from Manufactured Aggregates with Different Mix Designs				
	M-1	M-2	M-3	M-4
Dry Unit Weight, lb./ft.³	106.6	109.6	113.6	111.1
Water Absorption, lb./ft.³	16.5	14.7	12.1	14.2
Compressive Strength, psi	2,360	2,410	2,530	2,350
Dry Shrinkage, %	0.038	0.037	0.034	0.037

With one exception, the properties of blocks produced using manufactured aggregates with different mix designs met the ASTM specification for medium-weight concrete masonry units (Table 4). The one exception was for water absorption in the M-1 mix design. These results indicate that blocks made from manufactured aggregates having various mix designs can meet the ASTM concrete block specification. A commercial extruder with better compaction capacity may reduce aggregate water absorption in the M-1 mix design to meet the block specification.

The above results indicate that manufactured aggregates made from Mirant-Birchwood spray-dryer ash can be used as lightweight aggregates, replacing conventional lightweight aggregates for medium-weight block production within the target market area. The amount of manufactured lightweight aggregate required in the block production is less than the amount required when using conventional lightweight aggregate.

Based on economic analyses, the minimum economically viable dry scrubber ash processing rate for a manufactured aggregate plant is 100,000 tons per year. The Mirant-Birchwood Facility currently produces 115,000 tons per year of spray-dryer ash, and based on the process economics, the Mirant-Birchwood Facility is of acceptable size for a commercial demonstration.

The proposed facility would convert the 115,000 tons per year SDA ash into about 167,000 tons per year of lightweight aggregate. Based on a marketing survey of the Baltimore-Richmond I-95 corridor, the current demand for lightweight aggregates in the Virginia-Maryland area is estimated at 350,000 tons per year, with the selling price exceeding the estimated production costs. The lightweight aggregates would be sold to commercial block manufacturers to produce lightweight concrete blocks.

2.0 PURPOSE AND NEED FOR ACTION

The U.S. Department of Energy developed the Power Plant Improvement Initiative (PPII) to provide industry with an opportunity to look at new ways for improving operations of the nation's 450 existing coal-fired power plants. The PPII encouraged proposals to develop new technologies that could either increase the amount of power currently being generated or that could help plants to avoid premature shutdowns by installing more effective or lower-cost pollution control technologies.

The latter approach – installing more effective or lower cost pollution controls - is of interest to power generators since there is uncertainty about future methods for disposal of CCBs. In some cases, concern about the disposal of CCBs has delayed commitments to construct new facilities, perhaps resulting in power shortages and decreasing the reliability of the electrical grid. The cost of waste disposal continues to grow as increasingly stringent landfill regulations become effective.

While pilot-plant and bench-scale testing has demonstrated the technical feasibility of the lightweight aggregate production process, industry acceptance requires the demonstration of commercial feasibility which includes these key objectives:

- **Demonstrate that the commercial-scale capital and fixed and variable operating costs are within range of the estimated values.**
- **Demonstrate that the planned process can produce ASTM specification lightweight aggregates 24 hours per day in commercial operation.**
- **Demonstrate that the manufactured lightweight aggregates can be used to produce ASTM specification, commercial construction products.**
- **Demonstrate market acceptance.**

The proposed project, "**Commercial Demonstration of the Manufactured Aggregate Processing Technology Utilizing Spray-dryer Ash,**" was one of eight selected from among 24 proposals submitted following a solicitation under the *Power Plant Improvement Initiative*. DOE reviewers chose this project as one that would best further the objectives of the initiative.

3.0 DESCRIPTION OF PROPOSED ACTION AND ALTERNATIVES

3.1 Proposed Action

The proposed action is for cost-shared financial support by DOE, through a cooperative agreement with Universal Aggregates, LLC, for the design, construction, and operation of a lightweight aggregate manufacturing plant at the Mirant-Birchwood Facility in King George County, Virginia. DOE would provide approximately 37 percent (\$7.2 million) of the \$19.6 million cost of the project over a 30-month period. The first 15 months of the project would involve primarily design and construction activities, followed by 15 months of testing and operation. The proposed facility would transform the 115,000 tons per year of spray-dryer ash currently generated by the Mirant-Birchwood Facility into 167,000 tons per year of lightweight aggregate for use in the manufacture of lightweight masonry blocks or lightweight concrete.

The process tailors aggregate properties to specific applications, such as aggregates for manufacture of lightweight concrete blocks, structural lightweight concrete, or aggregates for use in asphalt road paving. The process consists of mixing, extrusion, and moderate-temperature curing. It takes advantage of the cementitious properties of the extruded products for strength development. Optimizing the water addition and time during the mixing step and identifying the proper conditions for curing are important factors for the production of aggregates with high strength and other desirable properties for use in construction. A proprietary curing method was conceived to optimize aggregate strength development. Steam injection during curing, which often caused operational problems in other processes, is eliminated. The process (developed by Universal Aggregates, LLC) represents an advance in the state of the art, and as a result has been granted two U.S. patents (others are in preparation).

In simplest terms, the process feeds spray-dryer ash, water, and other components into a mixer where the materials are blended together (*Refer to Figure 1*). The mixing produces a uniformly blended, loose, moist, and granular material that feeds directly to an extruder. The extruder is equipped an auger that subjects the material to further mixing and then forces the material through a die (metal plate with one or more drilled or specially shaped holes). At the extruder outlet a cutting device is used to limit the length of the extruded pellets to manageable sizes.

"Green" pellets from the extruder are wet and soft, and must be transferred to a curing vessel for hardening. The curing vessel is a specially designed retention bin that provides for flow of solids without channeling or hang-up. The pellets cure/harden as they slowly move down through the vessel.

After curing, the hardened pellets (manufactured aggregate) are screened to remove fines and are either stockpiled or sent to crushing operations.

Universal Aggregates has been able to demonstrate conversion of SDA solids into manufactured aggregates in bench-scale batch, semi-continuous operations and continuous fully integrated pilot production runs. Batch tests produced 70 lb aggregate batches, while semi-continuous operations produced 200 to 300 lb batches. Fully integrated, continuous pilot-plant production runs (450 to 650 lb/hr of green aggregates) were conducted on a 24-hour basis, producing large quantities of cured aggregates for full-scale testing by concrete masonry block manufacturers.

Scale-up of most of the manufactured aggregate process equipment, i.e., belt and screw conveyors, bucket elevators, crushers, and screens would not be a concern. The operation of these components is adaptable and simple, and successful performance has been demonstrated in other solids handling processes. However, there is a need to demonstrate the scale-up of key equipment; the solids mixer that precedes the extruder, the extruder, and the curing vessel. The mixer/extruder equipment combination is used at clay brick plants. Additionally, the ease of extrusion is a function of the mix plasticity which is dependent upon water added, particle shear, mixing intensity, and duration.

The proposed site for the manufactured aggregate plant is on the property of the 238 MW_{net}, Mirant-Birchwood Facility. Figure 2 shows the proposed site location, and Figure 3 shows an aerial view of the Mirant-Birchwood Facility and proposed project site. The Mirant-Birchwood Facility, located in King George County, Virginia approximately 10 miles east southeast of Fredericksburg, is a cogeneration unit producing both power which is sold to the public, and process steam which is used to heat local greenhouses. It is equipped with a lime spray-dryer for SO₂ control and produces about 115,000 tons of ash annually.

The proposed aggregate plant would be located north of the boiler house on a tract of less than 5 acres and would utilize approximately 3 acres of land. An elevated pipe bridge, over railroad tracks, would be installed to allow pneumatic transfer of SDA solids from the existing SDA silo to the aggregate plant. A new truck scale for weighing incoming shipments and outgoing product shipments would be located on the south side near the aggregate plant entrance. Construction of the main plant would require approximately 0.75 acres, including area for personnel parking; a 48' x 72' two-story building which would house most of the process equipment including day bins, weigh feeders, solids mixer, and extruder; a single trailer for the control room, lab, and locker room; a 24' x 35', two-story

building for crushing and screening operations; outside storage silos for admixtures; and the curing vessel. Approximately 2 acres would be required on the east side of the plant for radial stacker storage of crushed products. A plan view of the Birchwood Manufactured Aggregate Plant is shown in Figure 4.

Universal Aggregates anticipates that the lightweight aggregate manufacturing plant would continue to operate beyond the demonstration period due to its economic viability. Proponents for the aggregate plant have agreed to host visits of potential new customers for both the manufactured aggregate process and the lightweight aggregate product. Such long-term site access would assist in the commercialization of the process.

3.2 Alternatives

3.2.1 Alternative Sites

The purpose of the Power Plant Improvement Initiative is to pursue the development of technologies that could either increase the amount of power currently being generated or that could help power plants avoid premature shutdowns by installing more effective or lower-cost pollution control technologies. As a result, the proposed action is for DOE to provide cost-shared financial support through a cooperative agreement with Universal Aggregates, LLC. As a cost-shared effort, the project is actually owned and controlled by a sponsor, other than the federal government, and therefore, the scope of alternatives is necessarily more restricted. The agency must focus on alternative ways to accomplish its purpose, reflecting both the application before it and the functions the agency plays in the decision process. It is appropriate in such cases for DOE to give substantial consideration to the applicant's needs when establishing a project's reasonable alternatives.

Potential project sites are limited to locations having existing spray dryers and those with spray dryers under construction. There are currently 21 spray dryers of adequate size operating in the United States, while 5 spray-dryer installations are under construction or in the planning stage. Marketing studies indicate that the selling price of lightweight aggregate is sufficient to justify a commercial plant at each location. However, the cost of the reagents and transportation distance to lightweight aggregate markets makes some of the facilities economically unattractive.

The location for the proposed project was selected by the industrial partner (Universal Aggregates, LLC), solely using the industrial partner's resources, prior to the submission of the proposal to DOE. In cases where a private party petitions the federal government for grants or permit approvals based on a specified proposed action at a specified location, and the private party submits for government review significant quantities of information on the proposed action at a specific proposed location, the federal government is limited in its consideration of alternatives to (1) the proposed action at the proposed location and (2) the "No Action" alternative. The action currently under NEPA review is whether to accept or reject a specific proposal by a private party. The private party's proposal must be either accepted or rejected in whole, not in part. Therefore, because alternative sites were not proposed by the petitioner, alternative sites for the proposed project location are not considered in this EA.

The proposed action would result in the generation of information that would permit decisions by the private sector regarding the long-term feasibility of manufacturing aggregates from spray-dryer ash. Because of the perceived environmental and economic benefits of this process, a successful demonstration may result in decision to construct similar facilities at other locations. However, at this time no other similar projects are known to be in planning or design phases. For prospective future manufactured aggregate plants, environmental impacts and societal/economic impacts that are location dependent cannot be addressed at this time. Most of the possible adverse impacts would be location dependent. Most of the beneficial impacts cited for this project, such as promoting SO_x scrubbing at power plants, would apply to similar projects at other sites.

3.2.2 No Action Alternative

The "No Action" alternative is that DOE would not provide funding for the commercial-scale demonstration of manufacture of lightweight aggregate from spray-dryer ash. Under the No Action alternative, the King George Landfill would be expected to continue to use the spray-dryer ash from the Mirant-Birchwood Facility as daily cover, and tipping fees would continue to be paid to the county for disposal costs.

The main environmental impacts of the No Action alternative are:

- more waste materials would be sent to landfills;
- more raw materials would likely be mined to meet the demand for conventional lightweight aggregates;

- power plants would be less likely to install FGD systems to remove SO_x pollution;
- more fuel would be used to haul lightweight aggregates from the few existing supply locations to the sites of demand; and,
- higher energy-consumption would occur in conventional lightweight manufacturing processes.

The main societal/economic impacts of the No Action alternative are:

- potentially higher costs of electricity in the future, with the costs being related to landfill tipping fees;
- potentially higher costs of lightweight concrete and concrete masonry block;
- potentially higher costs of construction with standard concrete and concrete masonry, when lightweight concrete could have been used;
- potentially fewer jobs and potentially less tax revenue from personal income, corporate income, property, sales, etc.; and,
- continued importation of lightweight aggregates from other countries.

Given the impacts of the No Action alternative, it is likely that the private sector would eventually proceed with construction of commercial-scale manufactured aggregated plants; however, more time would be required to raise the capital. In the short-term, the private sector may remain reluctant to provide the capital and test the proposed technologies.

4.0 AFFECTED ENVIRONMENT

The proposed project site would be located on a parcel of less than 5 acres within the confines of the Mirant-Birchwood Power Plant property located in western King George County, Virginia. The proposed site is located near State Route 665, north of the State Route 3 intersection and approximately one mile north of the Rappahannock River. The proposed plant would be constructed in the north-central part of the power plant tract. A portion of land north of the railroad consists of woodland. A regional environmental constraint map is provided as Figure 5, while Figure 6 shows the environmental constraints in the immediate vicinity of the proposed site.

4.1 Geology and Soils

The project site is located in the Coastal Plain Physiographic Province. The surface elevation throughout the site is approximately 100 feet above mean sea level. Geologically, the area is underlain by lower Tertiary- to Quaternary-age deposits. Higher elevations contain riverine terrace and bay deposits of sand, silt, and clay of the lower to middle Pleistocene-age Shirley Formation and Charles City Formation.

Soils at the proposed site have been previously disturbed during construction of the Mirant-Birchwood Facility and then reseeded with various grass species. The soils are deep; well drained to moderately well-drained with heavy clay loam, sandy loam, clay loam, or clay subsoil. The soil survey map, Figure 7, identifies the following soil series at the Mirant-Birchwood Facility: Roanoke silt loam, Altavista fine sandy loam, Wickham sandy loam, Turbeville loam, Galestown-Sassafras complex, Caroline Sassafras complex, Wahee silt loam, and Augusta loam. These soils are found on Coastal Plain uplands or stream terraces. The predominant soils identified in the immediate construction area are Turbeville loam (TuA, TuB) and Altavista fine sandy loam (AfB). A review of aerial photographs indicates the soils in the immediate proposed construction area were disturbed during construction of the power plant. Roanoke silt loam (Ro) is located in undisturbed areas to the north of the proposed project site.

4.2 Hydrology

Based on the topography of the area, groundwater and surface water flow to the south-southeast towards the Rappahannock River. The immediate project area surface water runoff flows toward the woodland area to the north.

Shallow groundwater occurs at a depth of 15 to 25 feet, discharging to two tributaries of the Rappahannock River. One tributary parallels the western power plant site boundary and one tributary flows approximately southeast and then southwest direction parallel to the eastern site boundary. These tributaries flow into Birchwood Run, a small second-order perennial stream located generally to the south and east of the project site. Birchwood Run enters the Rappahannock River 3.2 miles from the project site. (Refer to *Figure 2*).

Stormwater runoff is a function of the soil conditions, topography, vegetative cover, and precipitation. The proposed site is primarily a grassed field covering previously disturbed soils. Approximately 90 percent of the Mirant-Birchwood Facility property is grassland and the remainder of the property is wooded buffer. Forested areas typically generate little runoff of stormwater. The primary source of existing stormwater runoff is the railroad drainage. Railroad drainage trenches carry water runoff to an unnamed tributary of Birchwood Run. Although much of the site has vegetation, some bare soil is found and subject to removal from stormwater runoff. However, no major stormwater problems have been identified on the site. No evidence of significant erosion (i.e., gullies, etc.) has been observed on-site.

4.3 Cultural Resources

A Cultural Resource Survey was completed in May 1991 prior to the construction of the Mirant-Birchwood Facility. The survey included the parcel for the proposed project. The study, conducted by staff of the William and Mary Center for Archaeological Research in accordance with an agreement with Westinghouse Environmental and Geotechnical Services, Inc. (Westinghouse) of Richmond, Virginia, was intended to provide specific information concerning the nature and distribution of potential archaeological resources within the project area. Background research of existing archaeological sites within a 5-mile radius of the project area was conducted along with an evaluation of extant documentary and cartographic sources pertinent to the project area, and a field survey of the 41-acre construction area and 1.6-mile pipeline corridor that included a systematic surface inspection and a subsurface shovel testing in areas covered in vegetation.

The field investigation of the proposed project area was intended to detect natural and cultural evidence, which would indicate the presence of archaeological sites. Natural and cultural indicators included land form features, soil anomalies, patterns of vegetation, lithic resources, and concentrations of artifacts.

Site locations 5, 17, and 18, were located in the vicinity of the proposed aggregate plant (*Refer to Figure 8*). A review of aerial photographs documented the fact that previous disturbances had occurred to project area soils.

In addition, Sites 44KG100 and 44KG103 are located within the proposed footprint of the aggregate facility. These sites were characterized as low-to-moderate-density prehistoric lithic scatters. Diagnostic hafted bifaces recovered from these sites indicated association with the Middle to Late Archaic Periods (ca. 5000 to 1000 B.C.). It was concluded they represent the remains of ephemeral resource procurement camps. The cultural deposits at Sites 44KG100 and 44KG103 were limited to a depth of approximately 26 centimeters. Since the sites have been impacted by agricultural plowing and site grading from the power plant preparation, the Phase I archaeological investigation determined these sites were effectively studied and their research potential was deemed insignificant. No further archaeological study was recommended. These sites, as well as the other nearby archaeological sites were by definition, not eligible for further archaeological study.

4.4 Ecological Resources

Grassland and woodland vegetation plant communities are present within and adjacent to the project site. Various planted grass species and broom sedge dominate the soils disturbed from site grading for the Mirant-Birchwood Facility. Approximately 90 percent of the project site is open field with previously disturbed soils.

Areas to the northeast are mature mixed pine/hardwood forest that will remain undisturbed by construction and operation of the proposed facility. The dominant deciduous species are sweet gum and various species of oak. The co-dominant pines, located primarily in the northern portion of the site, are loblolly pine and scrub or Virginia pine. Other species noted include American beech, American holly, red-cedar, common greenbrier, and Japanese honeysuckle. Along the stream drainages to the north are stands of river birch, red maple, and silver maple.

In general, the surrounding forested areas are typical of most temperate deciduous forests. The canopy is mostly closed, the understory is thick, and a large amount of dead vegetation is present on the forest floor. This diversity of structural features (i.e., live and dead vegetation, water bodies, and non-vegetated substrates) results in heterogeneous wildlife habitats. Forest/open field edge, or ecotone, habitat also exists along the north edge of the project site. A portion of the project site field is mowed or periodically cut, which helps maintain edge habitat. Dominant species of

the woodland fringe habitat include blackberry, multiflora rose, thistles, broom sedge, and sumac.

Birchwood Run, a perennial stream, and its tributaries straddle the power plant property. One such tributary is located approximately 1,000 feet northeast of the proposed project site.

Due to the rural, agricultural setting of King George County, wildlife is abundant. The mixed pine/hardwood forest provides high-quality habitat for reptiles and mammals, as well as numerous species of birds. In addition, a number of shallow and ephemeral ponds exist near the site of the proposed project that supports a variety of amphibians. The principal game species in the area are white-tailed deer, eastern cottontail rabbit, gray squirrel, ruffed grouse, wild turkey, and quail. Fur bearers in the area likely include raccoon, beaver, and eastern gray fox. Typical bird species include the cardinal, purple finch, swallow, wood thrush, warblers, American crow, and pileated woodpecker. In addition, birds such as osprey, heron, and kingfisher are found in the area. Migratory species such as the mourning dove, woodcock, and various waterfowl frequent the area. A number of raptors such as owls and red-tailed hawks are also found in the area.

Birchwood Run may support fish populations. However, no fish collection records for this stream are on file with the Virginia Department of Game and Inland Fisheries (VDGIF). No fish were observed in the unnamed tributary of Birchwood Run located off-site to the northeast.

4.5 Threatened and Endangered Species

According to the Virginia Department of Conservation and Recreation, and the Virginia Division of Natural Heritage, no records of rare, threatened, or endangered species or natural communities exist on or adjacent to the proposed site. However, the VDGIF reports two "species of special status," the bald eagle and the eastern tiger salamander, as possibly occurring near the project site. In addition, the pygmy shrew, a federal candidate species, is known to occur along the Rappahannock River in King George County. The presence of potential habitat for these three species was investigated during a site reconnaissance survey conducted on January 29, 2002.

The bald eagle, a federal endangered species, is known to nest along the Potomac River and Rappahannock River, within a few miles of the proposed site. However, field observations have reported neither bald eagle rearing nor nesting habitat on the site or within its vicinity. Bald eagles have not been reported on or adjacent to the project site, but

occasional visits to the site or roosting by eagles could occur in wooded areas to the north.

The eastern tiger salamander, a state endangered species, requires habitat with a suitable substrate for burrowing (especially sand), ephemeral pools that are preferably exposed, and suitable medium for egg attachment (grasses and stumps). Although the actual occurrence of tiger salamanders cannot be dismissed entirely, field observations indicate no high-quality habitat is present on or near the proposed project site. The ephemeral ponds on the property to the north are covered by a closed tree canopy and contain silt, which makes a poor environment for this species.

The pygmy shrew, a federal candidate species, has been collected in King George County along the Rappahannock River. The pygmy shrew occurs over a wide range of habitat types, from dry to moist woodlands to old field and edge habitats. The preferred cover types include dense vines and/or dead plant material, such as leaf mold or rotting logs. Field observations suggest that such habitat does exist north of the project site, but not within the area proposed to be developed. The pygmy shrew is not currently listed or proposed for listing as a federal or state threatened or endangered species, and therefore, is not protected by state or federal endangered species legislation.

Table 5 shows the threatened and endangered species and state and federal rank, as well as "five habitat communities" which are endangered and worthy of protection. The project site is not associated with these plant community types.

Table 5 - Threatened and Endangered Species Natural Heritage Resources of King George County, Virginia				
Type	Species Name	Common Name	Global Rank	State Rank
Birds	Haliaeetus leucocephalus	Bald Eagle	G4	S2
Communities	N/A	Brackish Marsh	--	--
Communities	N/A	Salt Scrub	--	--
Communities	N/A	Coastal Plain Bottomland Hardwoods	--	--
Communities	N/A	Coastal Plain Depression Pond	--	--

Communities	N/A	Mesic Mixed Hardwood Forest	--	--
Invertebrates	Agelenopsis kastoni	Funnel-Web Spider	G4	S2
Non-Vascular Plants	Sphagnum trinitense	Trinidad Peatmoss	G4	S2
Vascular Plants	Bolboschoenus fluviatilis	River Bulrush	G5	S1

Ranking Denotions:

State Rankings:

- S1-Extremely rare, usually 5 or fewer populations or occurrences in the state; or may be a few remaining individuals; often especially vulnerable to extirpation.**
- S2-Very rare; usually between 5 and 20 populations or occurrences; or with many individuals in fewer occurrences; often susceptible to becoming extirpated.**
- S3-Rare to uncommon; usually between 20 and 100 populations or occurrences; may have fewer occurrences, but with a large number of individuals in some populations; may be susceptible to large-scale disturbances.**
- S4-Common; usually >100 populations or occurrences, but may be fewer with many large populations; may be restricted to only a portion of the state; usually not susceptible to immediate threats.**
- S5-Very common; demonstrably secure under present conditions.**

Global Rankings:

Global Ranks are similar, but refer to a species' rarity throughout its total range. Global ranks are denoted with a "G" followed by a number. The global and state ranks combined (e.g. G2/S1) give an instant grasp of a species' known rarity.

4.6 Water Resources

The Rappahannock River, located approximately 1 mile south of the site, is identified as a Riverine, Tidal, Open-Water, Permanent tidal wetland on the National Wetland Inventory (NWI) map. However, no wetlands are located on the proposed project site. Birchwood Run, a tributary to the Rappahannock River is situated to the south and east of the site. Water

drainage from the site would flow into Birchwood Run via low-order tributaries of Birchwood Run that can have intermittent flow during the year. The surface water drainage on site is within a Resource Protection Area (RPA) designated by King George County. The Mirant-Birchwood Facility property, including the proposed project site, is not in the floodplain of any streams.

4.7 Air Quality

The proposed site is adjacent to the Mirant-Birchwood Facility in an area designated by the U.S. Environmental Protection Agency as "Better Than National Standards" or "Cannot Be Classified" for sulfur dioxide (SO₂), nitrogen dioxide (NO₂), carbon monoxide (CO), ozone, and particulate matter less than 10 microns (PM₁₀). Air quality in the area is good, as reflected in the background concentrations for criteria pollutants. Ambient levels for criteria pollutants are below National Ambient Air Quality Standards (NAAQS). The nearest Prevention of Significant Deterioration (PSD) Class I area is the Shenandoah National Park, located about 60 miles west and northwest of the proposed site. The nearest non-attainment area is Stafford County, the border of which is located about 3,000 feet west-southwest of the project site. Prevailing winds are generally out of the northwest and southwest.

4.8 Noise

Principal background noise sources in the region around the proposed project site include vehicular traffic on County Routes 605, 665, and State Route 3; rail traffic; and the Mirant-Birchwood Facility. The proposed project site is open area with no obstructive or reflective surfaces and is bordered to the north by a wooded buffer that is designated as a Resource Protection Area by King George County.

No sensitive noise receptors are located in the vicinity of the project site. Employees of the Mirant-Birchwood Facility wear hearing protection when and where necessary on the property.

4.9 Hazardous Wastes

An Environmental Site Assessment (ESA) was conducted to determine if materials regulated under the *Comprehensive Environmental Response, Compensation, and Liability Act* (CERCLA), the *Resource Conservation and Recovery Act* (RCRA), and other environmental laws and regulations were potentially located on the project site. The ESA consisted of a site walkover and a database search. The Mirant-Birchwood Facility has registered underground and above-ground storage tanks that are equipped with vapor-detection devices. No leaks have been reported. No additional

underground or above-ground storage tanks are planned for the proposed project site. There had been previous report of a waste spill at the King George County Landfill, but no migration off the landfill property was recorded. In addition, there was a reported leaking underground storage tank on a property located at 365 Kings Highway. This property is ³/₄ mile from the proposed project site but there is no opportunity for contamination migration to the project site, since the tank is no longer in service. Figure 9 shows the locations of all sites within 1¹/₄ miles of the project site.

The "accidental release" procedures that have been employed at the Mirant-Birchwood Facility since its origin are shown below in Table 6.

Table 6. Accidental Release Procedures –Mirant-Birchwood Facility		
Potential Accidental Release Point	Potential cause	Preventative Measures/ Cleanup Procedures
Receiving station for bulk liquid admixtures	Off-loading tank delivery, hose leak or breakage, or valve leak.	<p>Proper storage containment - stainless steel tank.</p> <p>Concrete "dike" at off-load station to contain potential spill or leak.</p> <p>Regular inspection of transfer line and valve - replace/repair as required.</p> <p>Maintain sorbent spill kit onsite for cleanup.</p> <p>Enforcement of safety procedures and industrial hygiene practices.</p> <p>Follow recommended Material Safety Data Sheets (MSDS) clean up and precautionary measures.</p> <p>Reclaim spilled material, if possible.</p>
Receiving station for dry, bulk reagent powders	Off-loading tank delivery (pneumatic) hose leak or	Proper silo storage containment and transfer

Table 6. Accidental Release Procedures –Mirant-Birchwood Facility		
Potential Accidental Release Point	Potential cause	Preventative Measures/ Cleanup Procedures
	breakage, or valve leak	<p>equipment.</p> <p>Regular inspection of transfer lines and valves - replace/repair as required.</p> <p>Vacuum clean up and reclaim spill, if possible.</p> <p>Enforcement of safety procedures and industrial hygiene practices.</p> <p>Follow recommended MSDS clean up and precautionary measures</p>
Continuous pneumatic transfer of spray-dryer ash - pipeline from generating station storage silo to the process facility.	Source of base raw feed product (spray-dryer ash) into process plant (aggregate manufacture).	<p>Regular inspection procedure for detection of leaks and breakage - repair/replace as required.</p> <p>Spill: clean up wet with water and reclaim, if possible.</p> <p>Vacuum clean up and reclaim.</p> <p>Enforcement of safety procedures and industrial hygiene practices.</p>
Aggregate process facility baghouse.	Leak from bag blockage or bag breakage.	<p>Regular inspection and maintenance procedure - replace bags/components, as required.</p> <p>Train operators for visual stack observation.</p>

4.10 Land Use

An historical review of past land use was conducted using a sequence of aerial maps dating from 1977 through 2000. Figure 10 shows how the property at the Mirant-Birchwood Facility appeared as a farm in 1977. Figure 11 shows little change as of 1980 when the property was still used as farmland. Figure 12 shows the development of the Mirant-Birchwood Facility as it appeared in 1998, indicating that the area of the proposed project was disturbed. Figure 13, taken in 2000, shows the plant as it now appears.

The Mirant-Birchwood Facility lies in a rural area, consisting of open land with little topographic relief. With the exception of the power plant and the adjacent King George County Landfill, land use in the vicinity of the site is predominately agricultural, residential and green space. The rail line that bisects the Mirant-Birchwood Facility property services Solite, Inc., the King George County Landfill, and the Mirant-Birchwood Facility, carrying an estimated one to two trains per week. Land surrounding the site is heavily wooded. Homes border the property approximately 4,000 feet to the northeast on County Road 605; 4,000 feet to the southwest; and to the southeast off State Highway 3. Homes to the northeast and northwest of the site are at an elevation approximately 50 feet above the site. The area approximately 300 feet southeast of the site is less densely wooded and generally slopes down from the power plant toward the Rappahannock River. There are no intervening hills between the site and the homes located southeast and southwest of the site. Land use of the proposed project site is currently open field.

4.11 Socioeconomic Conditions

King George County was formed from Richmond County in 1720 and renamed in honor of King George I. The county is part of the rapidly growing Fredericksburg Region, and is located in the northern area of what is known as Virginia's urban crescent, bounded on the north by the Potomac River and on the south by the Rappahannock River. The population of King George County is 16,803, having a median age of 35.1 years (Census 2000). The population of the county was 10,543 in 1980 and 13,572 in 1990.

Overall average personal income per sector for King George County in 1990 was \$32,905, and then \$46,580 in 2000, a 31 percent increase. During the same period, personal income in manufacturing increased 32 percent, in the government sector 42 percent, and in the service sector 33 percent (*Refer to Table 7*). Total full and part-time employment by industry has increased 4,540 from 1990-2000 (34 percent). During this same period the

number of manufacturing jobs decreased by 18 percent, while the number of government positions and service industry jobs increased 12 percent and 56 percent, respectively (*Refer to Table 8*).

	1990	2000	\$ Change	% Change
Overall average	\$32,905	\$46,580	\$13,675	31%
Manufacturing	\$22,086	\$32,589	\$10,503	32%
Government	\$43,652	\$73,414	\$30,762	42%
Service	\$23,927	\$35,912	\$11,985	33%

Primary employment sectors in King George County are federal civilian government, service, trade, and manufacturing. The major employer in the county is the Naval Surface Warfare Center (NAVSWC), which provides employment for over 3,400 civilian personnel. In addition to the base operations of NAVSWC, the Naval Space Surveillance Center, Naval Space Command, and the Aegis Training Center have assisted in attracting over 70 high-technology software engineering firms to the county. As of September 1998, the total civilian labor force within the county stood at 8,457, with an unemployment rate of 2 percent.

	1990	2000	# Change	% Change
Non-farm	8,875	13,415	4540	34%
Manufacturing	349	297	-52	-18%
Government	4,799	5,442	643	12%
Service	1,912	4,323	2411	56%

In general, manufacturing jobs in the county are declining, as represented by 52 positions lost from 1990-2000. But the average personal income that is provided by this type of job has increased 32 percent over the past decade. The highest non-farm industry increase was in the government sector with a 42 percent increase, followed by the service sector with a 33 percent increase. Despite the increase in personal income in manufacturing, this type of job falls below the county average personal income per sector.

The total labor force within a 30-minute commute zone of King George County is estimated to be about 67,000, and over 1,496,000 within a 60-minute commute zone. Several state and local programs are available to assist business expansion within the region.

Local economic activity, as measured in terms of retail sales, grew from \$42 million in 1992 to \$47 million in 1996. Median family income was \$38,210 in 1990, an increase of 85 percent from 1980, representing a 6 percent increase in real dollars. Assessed value of taxable real estate for 1998 was \$836 million.

4.12 Transportation

Roadways

The proposed project site is located near County Route 665; County Route 605 and State Highway 3 pass within one mile of the site. A railroad line owned and operated by RF&P traverses north of the proposed project site and the existing power plant. The Mirant-Birchwood Facility owns a single-track rail line, which traverses the southern margin of the site of the proposed facility, to supply coal to the plant. The rail line extends eastward to the site of the Solite quarry and carries about two trains per week.

The principal roadways may be more fully described as follows:

County Route 665 is a rural local road that bisects the Mirant-Birchwood Facility and is the principal access for the facility to Highway 3. Route 665 connects State Highway 3 with 605 and runs in a northeasterly direction. The surface is paved north of Highway 3. This road serves a number of residences located at the intersection of Routes 605 and 665. A left-turn lane exists for eastbound traffic on Highway 3 turning onto Route 665.

State Highway 3 is a state primary road. It is designated as a Minor Arterial. It connects the northern neck and middle peninsulas with northwestern Virginia. According to the King George Comprehensive Plan (1990), Highway 3 is operating at a desirable level of service. Through the project area, Highway 3 is a divided 4-lane highway with 2 to 6-foot gravel shoulders.

Peak hour turning movements at the principal intersections near the site and average daily traffic counts along the principal roads were conducted for the original Mirant-Birchwood Facility traffic study. The turning movements projected in that study were far below typical intersection capacities. By observation, these principal roads and intersections are still below capacity.

King George County is located in a competitive trucking market with more than 20 major lines authorized for interstate shipping. Delivery services

such as: Airborne, Emery, Federal Express, Purolator, and United Parcel Service serve regional airports and provide worldwide shipping.

Interstate 95, located 18 miles to the west, provides a 6-lane north-south transportation route from northern Maine to southern Florida. North-south travel in the county is supplemented by U.S. Route 301. East-west links are provided by Virginia Primary Route 3 and Route 218. Other primary local roads include Routes 205 and 206. The county has convenient connections to Interstate 66 in northern Virginia, Interstate 81 in the Shenandoah Valley, and Interstate 64 to the Port of Hampton Roads.

Air Service

Richmond International Airport, located within one-hour drive from King George County, provides commercial air, freight, and charter services. Three additional major airports, Dulles International Airport (northern Virginia), Ronald Reagan National Airport (Washington, D.C.), and Baltimore-Washington International Airport are located within a 90-minute drive. Shannon Airport, a general aviation facility (15 miles west of the proposed project site) provides charter, corporate, and commuter services and facilities. Shannon has a 3,000-foot paved runway and FAA approved lighting. In 2001, the nearby Stafford Regional Airport became operational and expanded the county's corporate, commuter, and air-freight service. The new facility serves as a reliever airport for Dulles International and Ronald Reagan National.

Waterways

Navigation channels include a 12-foot navigable channel in the Rappahannock River and a 24-foot channel accessible from King George County. Deep-water river ports are located in Alexandria on the Potomac River, and Richmond and Hopewell on the James River. Worldwide export markets are served by the Port of Hampton Roads, the largest natural harbor in the world and the nation's leading export harbor. Excellent seaport facilities are also available in Baltimore, which is within 90 minutes of King George County.

5.0 ENVIRONMENTAL IMPACTS

5.1 Geology and Soils

No direct impacts on regional geology and geological resources are expected as a result of the proposed project due to the small size of the site (less than 5 acres), and because aggregate stockpiling would be

limited, and no major earthwork or piling would be required. In addition, no pre-existing geological conditions have the potential to adversely impact construction or operation of the facility. Soil at the proposed project site was disturbed during construction of the Mirant-Birchwood Facility and therefore no major impact on soils would be expected from project construction.

However, spray-dryer ash from the Mirant-Birchwood Facility is currently used as a daily cover for the King George County Landfill to control disease vectors (birds, rodents, insects, etc.), fires, odor, and blowing litter. Daily cover for landfills may be soil, clay, sand, geo-textiles, chemical foams, tire chips (tires that have been shredded into small pieces), and bark and wood chips. A daily cover is approximately 6" thick, unless it is made of man-made textiles. Because the proposed project would utilize all of the spray-dryer ash, the landfill operation would need to find an alternative daily cover. Potential indirect impacts to soils from the proposed project are that additional lands could be disturbed to obtain soil materials as an alternative to the daily cover of spray-dryer ash. Although alternatives are being considered by the King George Landfill, a specific alternative has not been selected.

Additionally, lightweight aggregate is customarily produced from the thermal expansion of clay or shale, which is obtained by mining (removing overburden by conventional earth-moving methods). An expected outcome from successful demonstration of the proposed project is that additional lightweight aggregate manufacturing facilities utilizing coal-combustion waste products could be constructed throughout the United States. Impacts to soils and geology resulting from mining clay and shale would be reduced. However, this reduction may be offset by an increase in mining of soils for landfill cover.

5.2 Hydrology

The proposed project site is approximately 1,000 feet from a stream which has a riparian buffer zone (Resource Protection Area) established by King George County. The proposed project plans call for the avoidance of any significant intrusion into the Resource Protection Area.

Therefore, the proposed project would not directly impact any surface waters. A well would be drilled to supply potable water for the proposed facility; however, the quantity of water withdrawn would be minor.

A Stormwater Management Plan, as required by King George County, would be prepared and would include plans for detention facilities to control runoff. Therefore, no significant impacts would be expected from runoff at the site.

5.3 Cultural Resources

Based on the findings of the archaeological investigation conducted prior to the construction of the Mirant-Birchwood Facility, no historic properties would be affected by the proposed project. The two sites that may be impacted by the proposed project, Sites 44KG100 and 44KG103, required no further archeological investigation due to their compromised integrity. There are no potentially impacted sites that could be further developed for the benefit of the public. A letter from Virginia's Department of Historic Resources concurring with these findings can be found in Appendix C.

5.4 Ecological Resources

The proposed project site is vegetated by various grasses and other herbaceous species and is of low ecological value. The grasses were planted for erosion control and have limited food or cover potential for wildlife. The area is periodically mowed. Successional colonization of the project site by forests would not be permitted by the Mirant-Birchwood Facility during the life of the power plant. Woodland areas and designated Resource Protection Areas would be avoided by the proposed project. No significant impacts to ecological resources would be anticipated.

5.5 Threatened and Endangered Species

Ephemeral ponds on the property to the north are covered by a closed tree canopy and contain silt, which serves as poor habitat for state-endangered eastern tiger salamander. Furthermore, the proposed project would not disturb this area.

Field observations suggest that habitat for the federal candidate species, the pygmy shrew, does exist north of the project site but not within the area proposed to be developed. However, if the species is listed prior to completion of the project, an on-site survey may be necessary to verify lack of presence or suitable habitat. Finally, the U.S. Fish and Wildlife Service determined that the project is not likely to adversely affect any federally listed or proposed species or their designated critical habitat (See *Appendix C*).

5.6 Water Resources

Best Management Practices for erosion and sedimentation control and stormwater management would be employed during construction of the proposed project. An Erosion and Sedimentation Control Plan would be developed and submitted to the King George County Conservation District

for review and approval. The proposed project would not affect any wetlands. The nearest streams, tributaries of Birchwood Run, are protected by a riparian buffer and are approximately 1000 feet from the project site. Therefore, no impacts to water resources would be anticipated from the proposed project.

The proposed project site is not in the floodplain, and therefore no impacts to floodplains would occur.

5.7 Air Quality

King George County, Virginia, is presently in attainment for all six criteria pollutants as defined by the Clean Air Act (CAA) of 1977. In an attainment area, an important air permitting consideration is to determine whether the facility will be subject to Prevention of Significant Deterioration (PSD) regulations. The Commonwealth of Virginia has been delegated full authority to implement PSD regulations within the Commonwealth.

PSD regulations apply to major source categories that emit or have the potential to emit more than 100 tons per year of any pollutant subject to regulation under the CAA, or any major source which has the potential to emit 250 tons per year of any pollutant subject to regulations under the Act. However, the proposed plant would result in emissions below 100 tons per year, and is therefore not subject to PSD regulations.

A facility is considered a major source of air pollutant emissions if it emits 100 tons or more per year of any criteria pollutant, or 10 tons per year of any Hazardous Air Pollutant (HAP), or 25 tons per year of any combination of HAPs. The lightweight aggregate manufacturing facility is expected to emit only one criteria pollutant, PM₁₀, and no HAPs. Because emissions of PM₁₀ would be expected to be less than 100 tons per year, the facility would not be considered a major source. However, it is expected that the facility would be subject to Virginia Department of Environmental Quality construction and operating permit regulations for stationary emission sources.

No significant impact on air quality would be expected from the proposed project.

5.8 Noise

No noise-sensitive receptors are located in the vicinity of the project site. The project would cause a negligible increase in noise levels over the current condition; therefore noise impacts would be minor.

5.9 Hazardous Wastes

Although encounters are not anticipated, should site preparation work or construction work uncover hazardous or residual wastes, the wastes would be stockpiled, tested, transported, and disposed of in accordance with federal, state, and local regulations.

In addition, lightweight aggregate produced from spray-dryer ash has been subjected to the U.S. Environmental Protection Agency's Toxic Characteristic Leaching Procedures (TCLP) which is used to determine if a waste is hazardous under RCRA. The procedures are designed to simulate landfill disposal conditions where the used product would be co-mingled with other municipal waste. The lightweight manufactured aggregate was found non-hazardous (*Refer to Appendix D*). Further, the aggregate produced under the proposed project would not be stockpiled in large quantities. No hazardous waste impacts are expected.

5.10 Land Use

The proposed project site is zoned for industrial use and should not conflict with surrounding land use.

5.11 Socioeconomic Effects

The manufacturing sector represents only about 2 percent of the total employment in King George County, but the proposed aggregate manufacturing facility would create nine jobs in this sector of the economy which currently is underrepresented. And, because transport of aggregates and reagents would involve an overall increase in hauling than currently required for the disposal (landfilling) of the spray-dryer ash, additional employment in the trucking industry would be necessary. Furthermore, successful demonstration of the technology would be expected to lead to additional lightweight aggregate manufacturing facilities utilizing FGD byproducts throughout the United States. A secondary economic impact would be the loss of revenue currently realized by King George County from landfilling the spray-dryer ash. This would be offset somewhat by the fact that the proposed facility would increase the county tax base.

In terms of environmental justice considerations, because the proposed project would be constructed on the property of the Mirant-Birchwood

Facility and is not expected to have significant adverse effects to human health or the environment, the project would not disproportionately impact minority or low-income populations.

5.12 Transportation

The proposed facility would be expected to generate only a negligible increase in traffic over current levels. The plant would produce 167,000 tons of aggregate per year. At 18 tons per load, this would result in 9,278 truckloads of processed aggregate exported from the site per year or approximately 20 to 30 trips per day. The vast majority of truck trips would use Route 665 and Highway 3, to I-95 near Fredericksburg. Loaded trucks would turn right from Route 665 to Highway 3. An estimated 75 percent of the trips would travel north toward Washington and Baltimore, while the remaining 25 percent of the trips would travel south toward Richmond and Norfolk. Empty delivery trucks that need to return to the facility would return on the same route. These trips would replace a similar number of existing trips between the power plant and the King George Landfill. However, traffic from the power plant to the landfill requires use of about 1 mile of Route 665.

With the plant employing 9 additional workers, this would result in 18 additional auto trips per day (9 in each direction). There would also be 360 tractor-trailer loads of reagent delivered to the site per year, an average of 1 or 2 trips in, and 1 or 2 trips out per day. During the 8-month construction period, approximately 800 truck trips would be necessary to deliver construction material to the site.

The majority of truck trips during construction as well as during normal operation would occur throughout the workday rather than during peak periods. The loading operation of the trucks will meter the flow of trucks to the highway system.

The traffic impact study revealed that the project would have no impact on existing highway capacities and no mitigation should be required.

6.0 CONCLUSIONS

No significant impacts to human health and safety or the environment are anticipated from the construction and operation of the proposed lightweight aggregate manufacturing facility. The proposed plant would be constructed on a previously disturbed site and no impacts to geology or soils would occur. Cultural resource investigations have been conducted and additional investigation was not warranted; therefore no further action pursuant to Section 106 of the National Historic Preservation Act is

required. No impacts are expected to ecological resources, water resources, or floodplains. Construction and operation of the proposed project would not be expected to impact any Federal or State listed threatened or endangered species. Although truck traffic would increase, roadways would be sufficient to handle the increased capacity, and therefore, transportation impacts would be minimal. Minor increases in noise and particulate matter (PM₁₀) would be expected.

The proposed facility would utilize all of the spray-dryer ash produced by the Mirant-Birchwood Facility which is being used by the King George County Landfill as daily cover. Therefore, with project implementation, the landfill would have to secure other material for cover and could result in additional areas being disturbed for soil/sand borrow. Alternatives for cover do exist in the landfill industry that may be more environmentally sound, however. Furthermore, King George County would not receive the \$5 per ton tipping fees that are currently being collected for disposal of the spray-dryer ash in the landfill, but the proposed facility would provide additional employment in the manufacturing sector and an increased tax base for the county. The King George Planning Commission has supported implementation of the proposed project in that they approved a special exemption and modification of the proffer statement from Mirant-Birchwood Facility to enable Universal Aggregates LLC, to design, construct and operate the lightweight manufactured aggregate facility.

Successful demonstration of the technology could result in additional lightweight aggregate manufacturing facilities throughout the United States. Additional environmental benefits from widespread implementation of this technology could be a reduction of landfilling of FGD waste products as well as a reduction in the impacts from mining associated with conventionally-produced, expanded clay/shale-based, lightweight aggregates.