TEXAS DEPARTMENT OF TRANSPORTATION

Texas Department of Transportation

TECHNICAL ADVISORY

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Fly Ash Supply - Full Version

Fly ash, a by-product of coal-fired power plants, is the most commonly used supplementary cementitious material in the world.

Over the last 10 years, TxDOT has relied heavily on fly ash to improve the long-term durability of concrete. Given the current EPA regulations for pollution control and the 2008 impoundment failure in Kingston, Tennessee, the future supply of fly ash is less predictable.

The following is a brief description of current issues the fly ash industry and its customers are facing and must contend with in the near future.

➡ CURRENT STATUS OF FLY ASH SUPPLY

There are currently 35 approved fly ash sources on TxDOT's Material Producer List, 16 are in Texas and supply the vast majority of ash to TxDOT projects. Of these 16 fly ash sources, six are Class F and 10 are Class C. See *Figure 1. Map of Texas Fly Ash Sources* for more details about the location of Texas fly ash sources.

The first issue that affects the supply of fly ash is geographic location. Most fly ash sources and the majority of the Texas lignite coal deposits are located in central to northeast Texas. There are a few fly ash sources in and around the Texas panhandle. As a result, it is often difficult for western districts to get fly ash. When fly ash is specified in these regions, the cost of concrete can increase significantly due to the increased shipping cost of the fly ash.

The second issue that impacts fly ash supply is the scheduled and unscheduled maintenance (outages) to power plant equipment. When one plant is down or collecting at a reduced rate, a strain is placed on the local fly ash market. If additional plants in the local area go down, then the local supply of fly ash can be strained to the point customers are placed on allocations.

At any given time, there is a sufficient supply of fly ash in the state, just not necessarily in locations where demand is high. Customers (concrete suppliers) usually do not want to pay more in shipping cost for fly ash from 200 miles away.

The availability of Class F fly ash has been a concern lately. TxDOT relies heavily on Class F fly ash for ASR mitigation, sulfate attack and temperature control of mass concrete placements. Since all precast concrete products require concrete with fly ash, several districts are requiring Class F fly ash during summer pavement operations and more aggregates are being added to the Option 7 exclusion list. The demand for Class F fly ash has also increased in several of the local fly ash markets. The fly ash industry has stated that the supply is there, but unforeseen outages could strain certain local markets.

➡ UNCERTAIN SHORT-TERM FUTURE OF FLY ASH

Over the past few years, coal combustion products (CCP), including fly ash, have become a major target of numerous environmental groups and the Environmental Protection Agency (EPA). With the 2008 fly ash impoundment failure in Tennessee, the issue of fly ash's potential hazard to the public has again been brought to the forefront.

In May 2010, the EPA released a proposal which listed two potential ways of handling the disposal and use of CCPs, including fly ash. The EPA has proposed to regulate CCPs by one of two regulatory options covered in the Resource Conservation and Recovery Act (RCRA): Subtitle C – Hazardous Waste Management or Subtitle D – Solid Waste Management.

Under Subtitle C, the EPA would regulate the waste stream and fly ash would be considered a "special waste" material. Fly ash would be handled and disposed of similar to hazardous waste. This would require fly ash to be disposed of in landfills or impoundments that meet the requirements of hazardous waste landfills. Under Subtitle D, the states would regulate disposal of fly ash and impoundment facilities would be required to meet stricter requirements. Both the utility and fly ash industries have been lobbying the EPA with the position against regulating fly ash under Subtitle C.

Regardless of which rule is accepted, the EPA has maintained that the "beneficial use" exemption for fly ash (e.g., use in construction materials) will remain and the use of fly ash will continue to be encouraged by the EPA. However, "beneficial use" of fly ash will only include uses when the fly ash is completely encapsulated, e.g., in concrete. The use of fly ash in soil stabilization may not be considered "beneficial use" of fly ash.

If fly ash is classified as a "special waste" material, there will be a possibility of the elimination of fly ash use as beneficial due to the liability utility companies and fly ash marketers may face. A final ruling is expected sometime during the fall of 2010.

If the beneficial use of fly ash is not affected by EPA's decision, the availability of Class F fly ash remains difficult for the industry to predict. It is difficult to provide an estimate of the availability of Class F fly ash because it is dependent on several factors that may change the quality or composition of the fly ash, which may result in a reduction of the amount of Class F fly ash available in the state. These factors include:

- **Switching to Powder River Basin coal (PRB) or blending of Texas lignite coal (TLC) and PRB.**
  The source of coal being burned as fuel dictates the class of fly ash collected. Most power plants producing Class F fly ash typically burn TLC or a blend of TLC and PRB. As the percentage of PRB increases in the blend, the composition of the fly ash changes to resemble a Class C fly ash due to the higher lime content of the PRB coal. Over the past few years, two of Texas' Class F fly ash sources have switched to a higher blend of PRB or 100% PRB. The choice of coal source is strictly the utility company's decision, usually dictated by economics and emissions standards with no regard to the impact on the concrete industry.

- **Using Activated Carbon Injection (ACI) for the removal of mercury.**
  Current EPA regulations limit the amount of mercury power plants can release into the atmosphere. One of the methods used to capture mercury is injection of activated carbon into the flue gas before the fly ash is collected. The mercury, which is in a vapor state, is absorbed by the activated carbon and captured in the fly ash.

  The presence of activated carbon in concrete is not usually an issue unless entrained air is desired. Carbon has a preference for air entraining admixtures and will absorb these admixtures until the carbon is saturated.

  Texas fly ashes have very low carbon contents (< 1.0%), but the carbon present varies in its absorbency from day to day. The variability of the carbon absorption in the fly ash, usually a result of the furnace temperatures, has typically been the cause of erratic air contents in the field in the past. As activated carbon is much more absorptive than the carbon already present in the fly ash, entraining air into concrete containing activated carbon fly ash will be virtually impossible.

- **Using selective catalytic reduction (SCR) controls for the removal of nitrogen and sulfur oxides (NOx and SOx).**
  EPA regulations limit the amount of NOx and SOx utility companies can release into the atmosphere. One method of removing these compounds from the flue gas is through the use of selective catalytic reduction (SCR).

  This process involves injecting ammonia into the flue gas, which reacts with the NOx and SOx and removes them from the flue gas. If the amount of ammonia injected into the flue gas is greater than the amount of NOx and SOx, the unreacted ammonia will be collected with the fly ash, typically as ammonia sulfates.

  The presence of ammonia in the fly ash does not affect the final properties of concrete, but it can cause a serviceability issue. Concrete containing high concentrations of ammonia will eventually release ammonia gas. Although this is not

an issue for transportation structures, it can be a problem for enclosed structures with limited fresh air flow and for concrete with concentrations of ammonia in the fly ash that exceeds 200 ppm.

The upcoming EPA ruling and any additional pollution control measures installed at the utility plants may create future issues with the fly ash supply in Texas. However, any shortages will likely be regional in nature and could be overcome by transporting fly ash over farther distances from other plants.

Fly ash, especially Class F fly ash, is an important component of durable concrete. With the potential for shortages in fly ash supply in parts of Texas, contractors and concrete suppliers should prepare to transport fly ash from farther distances and TxDOT should expect a resulting increase in the price of concrete.

➡ CONTACT INFORMATION

If you have questions regarding fly ash supply in your area, please contact:

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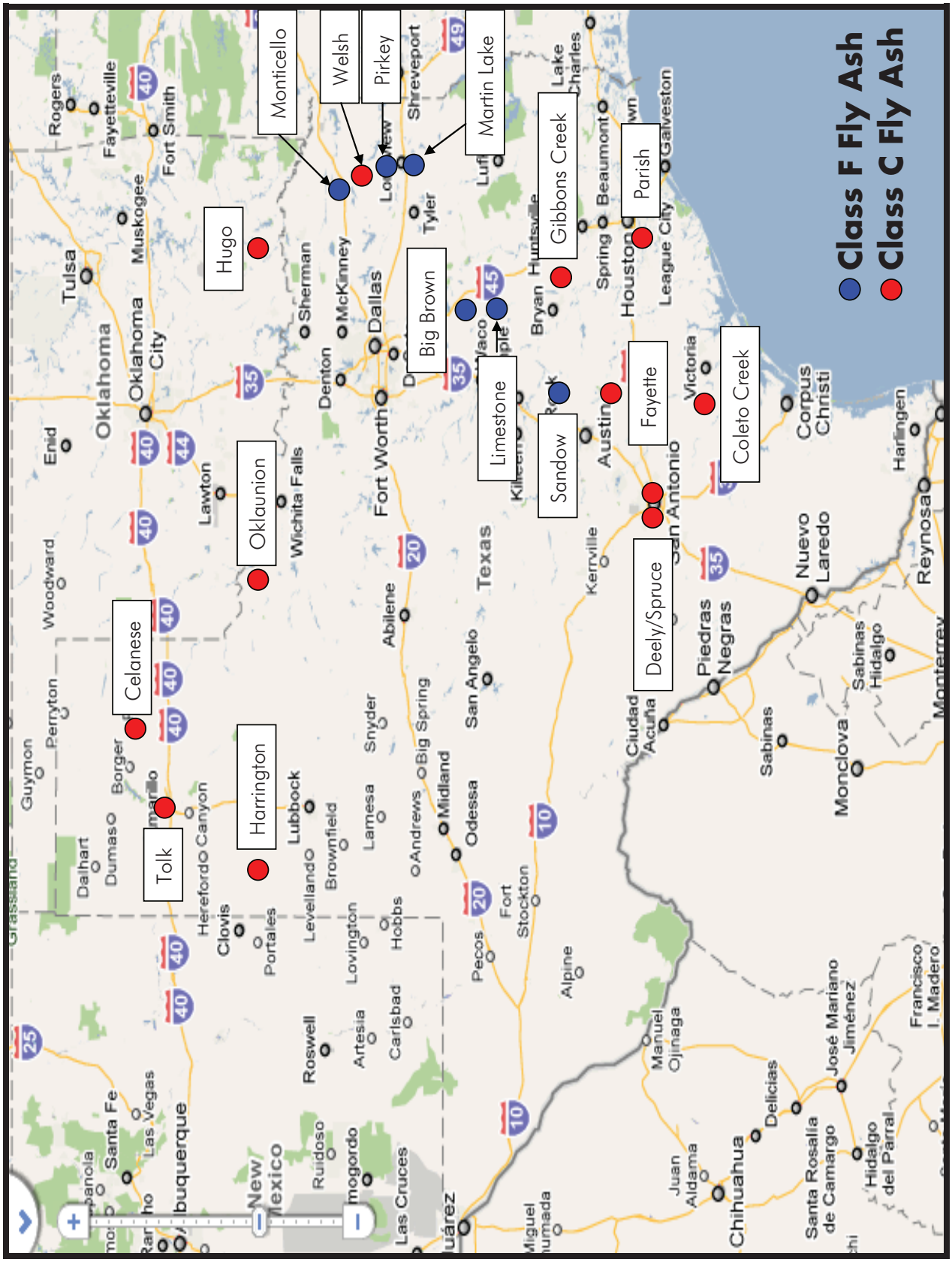

Figure 1. Map of Texas Fly Ash Sources