CALCULATIONS OF IMPACTS
GREENS LAKE 3D
SWG-2012-00906

Potential Project Impacts from Drilling Operations

Based on National Wetlands Inventory and topographic maps, 75,330.50 acres of the Greens Lake 3D project area are located in wetlands, 132,685.47 acres are located in open water, and 252,350.4 acres are located in upland areas (see attached map). There are 9,102 pre-plot source points located in wetlands, 30,470 in open water (4,718 shot holes in the Galveston Bay Complex, 2,838 in other open waters, and 22,914 airgun points in the Gulf of Mexico), and 28,007 in uplands [**See map titled Greens Lake 3D Project Pre-Plot with National Wetland Inventory (NWI) Data**].

Shot holes would be drilled at source point locations in wetland, open water, and upland areas. Shot holes proposed for this project are 110 feet deep and approximately 4 inches in diameter [**See sketch titled Cross-Section View of Single 110 ft. Shothole**]. Holes would be plugged in accordance with Railroad Commission of Texas Rule 100 and any drill cuttings (native soil) that are not returned to the hole would be spread in a thin layer around the surface of the hole.

If water is not readily available for drilling in wetland areas, water pits may have to be excavated to facilitate drilling. Should the excavation of water pits become necessary, the pits would be approximately 24 inches wide, by 48 inches long, and 24 inches deep [**See sketch titled Water Pit Excavated for Drilling**]. The pits would be dug using mini-excavators or backhoes mounted on either drilling or support equipment (i.e. airboats, marsh buggies, or swamp buggies) and the material excavated from the each pit would be returned to the hole and the area restored to pre-project contours upon completion of drilling of each hole.

The table below provides information on the volumes of material that could potentially be excavated from upland, wetland, and open water areas, the amount of fill (native soil) that could potentially be deposited in upland, wetland, and open water areas, and the acreages of uplands and wetlands that could potentially be affected by excavation and/or fill.

Habitat Type	Number of Source Points (Pre-Plot) in each Habitat Type	Cubic Yards of Native Soil Excavated from Drill Holes and Water Pits	Acres Affected by Excavation of Shot holes and Water Pits	Cubic Yards of Fill Material (Native Soil)	Acres Affected by Fill Material (Native Soil)
Wetlands	9,102	7,463.64	1.66	3,231.21	10.50
Uplands	28,007	9,942.48	0.06	9,942.48	32.30
Open Water (less Gulf of Mexico)	7,556	2,682.38	0.015	2,682.38	N/A

Calculations of Native Soil Excavated

To determine the amount of material that would be excavated from shot holes in wetland, open water and upland areas, the soil volume calculations of drill cuttings that would be removed from the hole and the amount of material that would be excavated from water pits (wetland areas only) and multiplied these figures by the number of holes estimated in each habitat type, as appropriate.

Approximately 0.355 cubic yards of drill cuttings would be excavated from each hole during drilling. This number was derived by calculating the volume of a cylinder ($V= \pi r^2 h$; V= 3.14 x 2 inches^2 (4) x 1,320 inches; 16,579.2 inches^3 = 0.355 cubic yards). Additionally, approximately 0.465 cubic yards of native material ($V= \pi r^2 h/2$; V= 3.14 x 24 inches^2 (576) x 24 inches ÷ 2; 21,703.68 inches^3 = 0.465 cubic yards) would be excavated from each water pit that is necessary in wetland areas.

This being the case, the number of drill holes proposed for location in wetland areas (9,102) was multiplied by 0.82 (the sum of the two) to calculate the volume (cubic yards) of material excavated in wetlands (7,463.64 cubic yards). Calculations of volume of native material excavated were based on the assumption that a pit would be dug at each shot hole location in wetland areas. This is not a likely scenario. If water is readily available for drilling at the shot hole location, a pit would not be necessary; therefore, figures provided in the table above represent the most conservative scenario.

Pits would not be necessary in upland or open water areas; therefore, the number of drill holes proposed for upland (28,007) and open water areas (7,556) was multiplied only by 0.355 (volume from shot holes) to calculate the volume (cubic yards) of material excavated in these habitat types (9,942.48 and 2,682.38 cubic yards, respectively).

Calculation of Acres Affected by Excavation

Only approximately 0.000002 acres of surface area is affected by the excavation of each 4 inch diameter drill hole, and approximately 0.00018 acres of surface area is affected by the excavation of each 24 inch x 48 inch water pit. Figures provided in the table for acres affected by excavation were calculated using these acreages, based on the same principles described above.

Calculation of Volumes of Fill

Volume (cubic yards) of fill material was calculated by multiplying 0.355 (cubic yards of drill cuttings excavated from each drill hole) by the number of holes in each habitat type. The numbers reflected in the table represent the most conservative scenario, assuming that the entirety of 0.355 cubic yards is removed from the hole and no native material is returned to the hole. This is not a true representation of fill. In wetland and open water areas, the substrate is softer and less consolidated than that of upland areas; therefore, much of the native material gets displaced to the sides of the hole during drilling rather than dispersed at the surface of the hole, so less than 0.355 cubic yards of material would result in fill in the surrounding area or water column. Additionally, reasonable efforts will be made to return drill cuttings to each respective source location (shot hole) on land-based portions of the project area; therefore, less than 0.355 cubic yards would result in fill. Estimates of fill included in the table are higher than those actually anticipated as a result of operations.

The volume of material excavated from pits in wetlands was not added to the volume of fill material reported in wetlands, as this native material is returned to its original location (pit) upon completion of the drilling of each hole and the pit location is restored to pre-project contours.

Calculation of Area Affected by Deposition of Drill Cuttings

The area affected by the deposition of drill cuttings around each hole is approximately 50.24 square feet, assuming a circle with a radius of 4 feet [**See sketch titled Area of Deposition of Drill Cuttings**]. This figure was multiplied by the number of drill holes in wetland and upland areas to calculate the acreage of fill for these habitat types. Area affected in open water areas would be highly variable depending on the amount of material actually released into the water column, the character of the sediment, water quality parameters, currents, tides, etc.; therefore, no estimate of area affected is included for open water areas.

Although the sediment removed from shot holes in open water areas may be discharged elsewhere as a result of current-driven sediment transport, complete natural backfilling of the hole will result in no net loss to water bottoms. Because of the soft nature of the substrate present within wetland and open water areas within the Greens Lake 3D project area, very little material is discharged at the surface of the hole. As the hole is drilled, the majority of the displaced material is compacted either outside the perimeter of the hole or downward toward the bottom of the hole. Approximately 0.355 cubic yards of native soil would be displaced in this manner during the drilling of each hole; however, as soon as the drill pipe is removed from the hole, the surrounding material collapses back into the hole column, naturally filling the hole in, without a need for artificial plugging.