April 2, 2012

Mr. James Kilgo
Rutherford County Solid Waste
P. O. Box 1957
Rutherfordton, NC 28139

Reference: Waste Transfer Station Slab Evaluation
Rutherford County C&D Landfill
Rutherfordton, North Carolina
GeoTechnologies Project No. 1-12-0084-EA

Dear Sir:

GeoTechnologies has completed the authorized evaluation of a slab failure in the waste transfer station building at the Rutherford County C&D Landfill in Rutherfordton, North Carolina. The purpose of this report is to present the findings of our field evaluation and to provide recommendations for repair of the slab.

The following figures and tables are attached to this report.

Table 1 Test Boring Summary
Figure 1 Site Plan With Boring Locations

VISUAL OBSERVATIONS

The transfer station building is approximately 78' x 78'. The topography at the building site slopes downward to the east. The building consists of 3 off loading bays, a transfer bay at the back of the building where waste materials are pushed into trailers parked in an open bay below the slab, and a small office area located at the northeast corner of the building. Three drainage grates have been installed in the floor slab to collect water runoff. The piping for the drains runs to the north. The grates have been partially covered with steel plates to keep waste out of the drains. Trucks back into the bays and dump garbage on the floor where it is then pushed into the waiting trailers with a John Deere 544J loader with solid tires. The gross weight of the loader with solid tires is approximately 30,000 pounds. The transfer station receives up to 70 heavy trucks per day with gross weights up to 65,000 pounds

The existing slab is severely cracked and exhibits settlement. The majority of the major distress is located in the center portion of the building on either side of the drain grates. The floor slab could be seen moving as loaded trucks and the front end loader crossed the joints. The joint spacing ranges from 8.5 to 20 feet. The joints do not appear to have been doweled. Several repairs have been made to the slab and the repairs are undergoing failure.

The original plans for the structure indicate that the slab was to contain 6 x 6 / 2.9 x 2.9 welded wire fabric. The slab was to be topped with Masterplate 200 topping. The topping has worn from the surface of the slab.

TEST BORINGS

A total of 6 test borings were completed in the floor slab. Boring depths ranged from 3.5 to 7.5 feet. The slab was cored with a diamond impregnated coring bit. Base and soil materials were removed from the borings with a hand auger. Representative samples of the subsurface soils were retained for visual classification. Consistency of the subsurface soils was evaluated using dynamic cone penetrometers (Corps of Engineers and Sowers). All holes were patched prior to leaving the site.

Thickness of the concrete ranged from 5.12 to 8 inches with an average thickness of 6.4 inches. The surface of the concrete has been abraded to the point that coarse aggregate is exposed in the surface. A polyethylene vapor barrier was observed beneath the concrete at borings B- 2 through B-6. Boring B-1 is in a repair area and no vapor barrier was observed at that location.

The slab at borings B-2, B-4, B-5, and B-6 is underlain with 1.38 to 2.25 inches of washed stone. The stone appears to be #67 size. No stone was encountered at boring B-3 and 8.6 inches of fine aggregate base course was observed in the slab repair at boring B-1. Washed stone was mixed into the upper 3 to 4 inches of subgrade at borings B-2, B-4, B-5, and B-6.

Voids were observed between the bottom of the slab and the washed stone at borings B-2 (1.5"), B-3 (2") and B-5 (0.25"). The slab was in full contact with the underlying base at the other boring locations.

The soils beneath the slab consist primarily of sandy clayey silts that are wet of optimum moisture content. The soils are very soft to stiff in consistency with blow counts of 1 to 15 blows per 1.75 inch increment. Fill soils were encountered in all of the test borings. The fill is deepest towards the rear retaining wall of the structure. The softest and least well compacted soils were encountered in the upper 3 feet.

ASPHALT PAVEMENT

One test boring, B-7, was placed in the asphalt pavement in front of the building. There are a number of patches in the pavements and all of the pavements exhibit alligator cracking. Thickness of the asphalt was 1.88 inches at the test location. Thickness of the aggregate base course stone was 6.67 inches. The aggregate base course was relatively loose at our test location and exhibited a CBR value of only 20 percent. The subgrade soils consist of stiff fine sandy clayey silt with an in-place CBR value of 19 percent. The asphalt pavement in two areas with broken pavement in front of the building was measured at 2 to 2.5 inches.

CONCLUSIONS

The distress exhibited in the transfer building slab is likely the result of several factors. None of these factors by themselves resulted entirely in the failure of the slab.

Slab Thickness

The thickness of the slab appears to be insufficient to support the traffic at the landfill. We do not know what the original traffic estimates were; however, based on the information supplied by the landfill, we estimate that the actual traffic is likely higher than originally estimated. We understand that there are approximately 70 large trucks delivering trash on a daily basis with gross weights up to 65,000 pounds. For estimation purposes, we have estimated a load distribution of trucks with weights ranging from 10,000 to 65,000 pounds gross weight. All trucks with weights of 25,000 pounds or greater are considered to have tandem rear axles. The total average daily ESAL's (Equivalent Single Axle Load) for the transfer station is approximately 277 with a 20 year total of 1,586,499 ESAL's. Using the AASHTO design chart for rigid pavements with average inputs for strength, environmental and loading factors, we have estimated the required thickness of the floor slab to be approximately 9 inches. This assumes minimal load transfer across joints and no reinforcement in the slab. Inclusion of dowel bars at joints and reinforcing steel in the slab would reduce the thickness by approximately one inch. These calculations do not include the loads from the 544J loader. The loader produces stresses similar to a fork lift on the slab. Based on our observations while at the site, the loader likely makes 150 to 200 passes across the slab on a daily basis. The additional stresses imparted by the loader would increase the thickness of the slab or at least require continuous reinforcement and load transfer devices. The slabs do contain a welded wire fabric; however, the wire will not provide sufficient load transfer across joints. The saw joints have produced slab geometry that is also conducive to cracking. Slab widths of 8.5 to 12 feet by 20 feet (W:D ratios of 2.35 to 1.67) have an increased potential for cracking. W:D ratios of 1.5 or less provide less potential for cracking.

The following table provides estimated load information for trucks at the landfill.

Daily Trucks	Gross Weight (lb.)	Front Axle (kips)	Rear Axle(s) (kips)	ESAL's Front Axle	ESAL's Rear Axle(s)	ESAL's Per Truck	ESAL's Per Day
30	65000	18	47	1	6.7	7.7	231
20	45000	18	27	1	0.74	1.74	34.8
20	25000	10	15	0.084	0.479	0.563	11.26
10	10000	4	6	0.02	0.01	0.03	0.3
					Daily Total		**277.36**
					20 Year Total		**1,586,499**

Support Conditions

The present condition of the subgrade is very poor. CBR values at the subgrade elevation ranged from 1.3 to 4.4 percent. Laboratory soaked CBR values for the clayey silts observed in the upper 3 feet of subgrade will typically be 2 to 4 percent. The moisture content of the soils is well above optimum moisture content. Water entering the cracks in the slab has likely contributed to the loss of support.

The slabs were placed over a polyethylene vapor barrier which was placed on top of washed stone. Thickness of the washed stone was generally 2.5 inches or less and was not present at two locations. Washed stone was observed to be mixed into the top 3 to 4 inches of subgrade. This condition was observed in areas where voids existed; therefore, it is likely that the stone was mixed into the subgrade prior to placement of the slabs. If the washed stone was mixed into the subgrade prior to concrete placement, it is likely that the subgrade soils were unstable at the time of placement.

RECOMMENDATIONS

The following recommendations are made based upon a review of the attached test boring data and past experience with similar projects and subsurface conditions. Should subsurface conditions adverse to those indicated by this report be encountered during rehabilitation of the transfer station building slab, those differences should be reported to us for review and comment.

It is our opinion that the floor slab in the transfer building should be replaced. Replacement of the slab must be preceded with repair of the soils beneath the slab in order to provide proper support for the replacement slab. Several conditions will impact the process used to replace the slab.

1. The existing building has been constructed such that the slab is tied to the walls. We do not know if the slab has been considered as part of the foundation support. We recommend that a structural engineer be employed to perform the necessary analyses to determine what must be done to maintain proper support of the structure during the slab repair and to determine if the new slab must be doweled into what is not removed.
2. The slab section which extends from the east retaining wall has been reinforced. A void was observed beneath the reinforced slab. The impact on the wall by removing the slab in order to repair the soils must be considered.
3. Any slab replacement should include reinforcing steel and load transfer devices at the joints. Because the new slab may be considered to provide some stability to the structure, we recommend that a structural engineer design the new slab. Design of the slab should take into account the loading from trucks as well as the wheel loader used to push trash into the hauling trailers.

We anticipate that at least 3 to 4 feet of existing soil will require removal from the slab area. We recommend that the exposed subgrade be inspected by a geotechnical engineer after removal of the initial 3 to 4 feet in order to identify areas that may require additional removal. Material used to replace the existing fill should consist of aggregate base course stone (CABC) compacted to 95 percent of the modified Proctor maximum dry density.

The asphalt pavements in front of the building should be reconstructed. We anticipate that the existing asphalt and aggregate base course will be removed. Although the subgrade was very stiff at our test location, we anticipate that subgrade repairs will be required. Subgrades should be compacted to not less than 98 percent of the standard Proctor (ASTM D-698) maximum dry density at +/-2 percent of optimum moisture content. Using the AASHTO method for flexible pavement design, a design structural number (SN) for the pavements is 4.0. The replacement pavement section would consist of 10 inches of aggregate base course stone, 4 inches of I19.0C binder and 3 inches of S9.5C surface mix. All base course stone and pavement materials should be produced and placed in accordance with NCDOT specifications.

SUMMARY

Replacement of the building slab will be necessary if the structure is to remain useable. Structural analyses will be required in order to determine the impact of removing and replacing the slab on the stability of the structure. The new slab must be designed to take into account the loads imparted by trucks and wheel loaders. We anticipate that at least 3 to 4 feet of soils will have to be removed from the building and replaced with properly compacted backfill. We recommend that aggregate base course stone be used as backfill. Construction of a new asphalt pavement section is also recommended for the approach to the building.

GeoTechnologies appreciates the opportunity to be of service to Rutherford County Solid Waste on this project. Please do not hesitate to contact us if you have any questions regarding this submittal.

Sincerely,

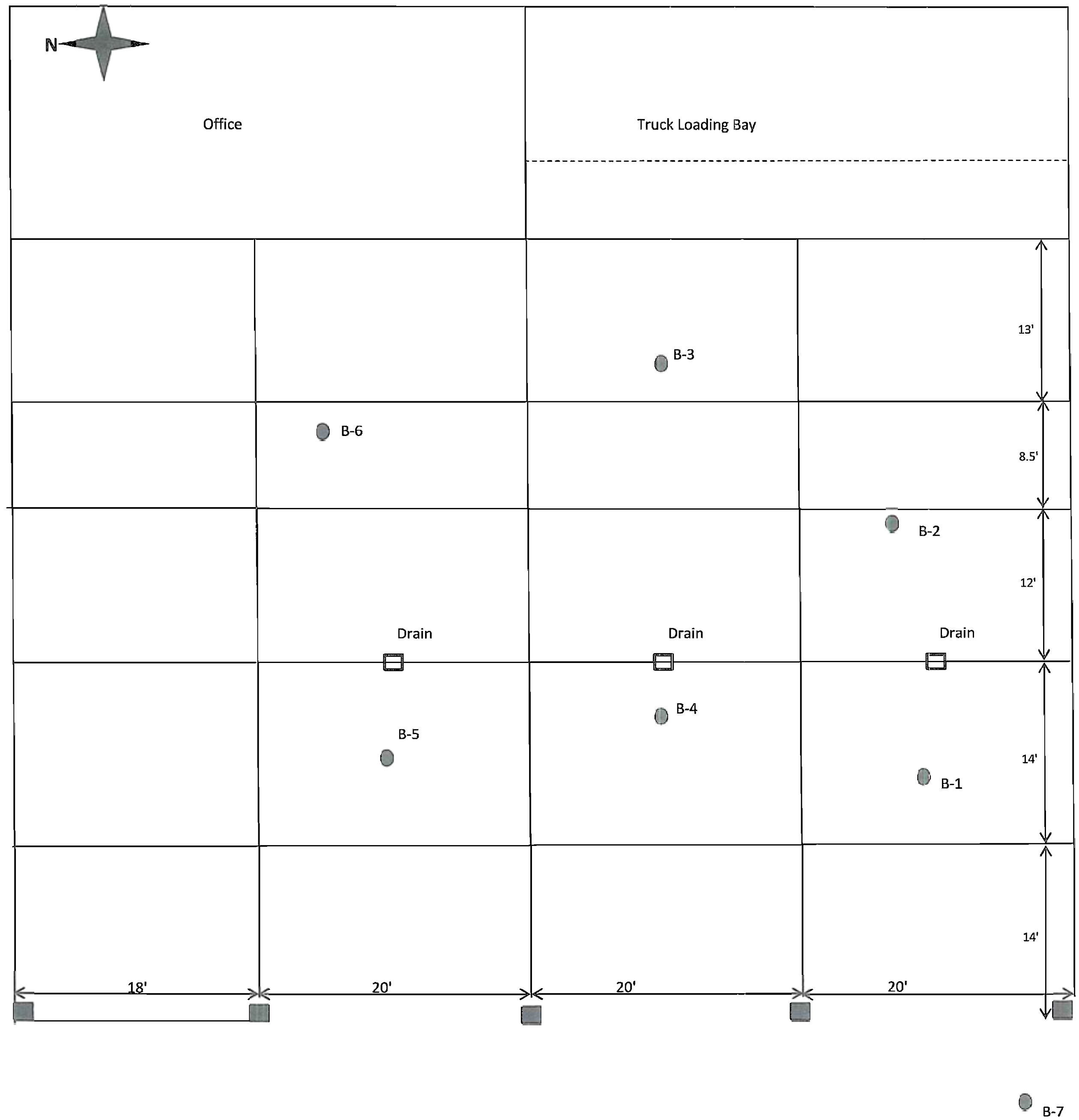
GeoTechnologies, Inc.

David R. Harris
Senior Inspector

Edward B. Hearn, P.E.
NC Reg. No. 9520

NORTH CAROLINA PROFESSIONAL SEAL 9520 ENGINEER EDWARD B. HEARN 4/2/12

Attachments



Rutherford County Solid Waste
Transfer Station
Rutherfordton, NC

Boring and Slab Layout

Projet No. 1-12-0084-EA
Scale: As Shown
Figure: 1

TABLE 1

TEST BORING SUMMARY

Transfer Station
Rutherford County C&D Landfill
Rutherfordton, North Carolina
GeoTechnologies Project No. 1-12-0084-EA

Boring	Depth (in.)	Description	CBR (%)	Dynamic Cone Penetrometer	
				Depth (in.)	Blows / 1.75"
B-1	0 - 6.38	Concrete Slab (Repair Area)			
	6.38 - 15	Very Loose Aggregate Base (3/4 Max. Size)			
	15 - 40	Orange Brown Medium to Fine Sandy CLAY w/ Fine Gravel (CL)	4.4 @ SG	16	6-7-8
	40 - 54	Orange Silty Coarse to Fine SAND (SM)	4.8 @ 18"	24	9-12-15
				36	7-9-11
				48	15/1.5"
B-2	0 - 5.5	Concrete Slab			
	5.5 - 7	Void			
	7	Vapor Barrier			
	7 - 7.75	Washed Stone			
	7.75 - 20	Orange Brown Medium to Fine Sandy Clayey SILT (ML) (Washed stone mixed in the upper 4 inches)	3.2 @ SG	10	1-1-3
	20	Obstruction		20	4-5-2
	20 - 40	Soft based on probing with 1/2" steel rod			
	40	Firm			

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Boring	Depth (in.)	Description	CBR (%)	Dynamic Cone Penetrometer Depth (in.)	Dynamic Cone Penetrometer Blows / 1.75"
B-3	0 - 8	Concrete Slab (Rebar @ 4.25" - #6 Bar)			
	8 - 10	Void			
	10	Vapor Barrier (No washed stone)			
	10 - 90	Orange Brown Medium to Fine Sandy Clayey SILT (ML)	1.3 @ SG	14	4-4-3
				24	3-1-2
				36	1/3.5"
				39.5	4-9-6
				48	6-5-3
				60	8-8-6
				72	6-5-4
				84	8-4-5
B-4	0 - 6.75	Concrete Slab			
	6.75 - 9	Washed Stone			
	9 - 19	Brown Medium to Fine Sandy Clayey SILT (ML) (Washed stone mixed in upper 3 to 4 inches)	3.4 @ SG	9	6-11-7
	19 - 48	Orange Medium to Fine Sandy Clayey SILT (ML)	7.3 @ 18"	24	5-9-15
	48	Rock in Side of hole - Probed firm below rock		36	10-10-10
				48	9-10-4

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Boring	Depth (in.)	Description	CBR (%)	Dynamic Cone Penetrometer Depth (in.)	Dynamic Cone Penetrometer Blows / 1.75"
B-5	0 - 5.12	Concrete Slab			
	5.12 - 5.38	Void			
	5.38 - 7.5	Washed Stone	3.5 @ SG	8	5-5-4
	7.5 - 20	Brown Medium to Fine Sandy Clayey SILT (ML) (Washed stone mixed in upper 3 to 4 inches)	7.5 @ 18"	24	7-8-9
	20 - 76	Orange Medium to Fine Sandy Clayey SILT (ML)		36	5-4-4
				48	8-9-10
				60	8-5-6
				72	15/1.75"
B-6	0 - 6.12	Concrete Slab (Crack)			
	6.12 - 8.5	Washed Stone			
	8.5 - 54	Orange Medium to Fine Sandy Clayey SILT (ML) (Washed stone mixed in upper 3 to 4 inches)	3.6 @ SG	9	4-5-8
			1.8 @ 18"	24	9-8-7
				36	7-8-8
				48	11-11-12
B-7	0 - 1.88	Asphalt Pavement (Alligator Cracking)			
	1.88 - 8.5	CABC Stone (CBR = 21%)			
	8.5 -	Orange Brown Medium to Fine Sandy Clayey SILT w/ Fine Grave. (ML)	19 @ SG		