M E M O R A N D U M

TO: Gary A. Abraham, Esq.

FROM: Anirban De, Ph.D., P.E.

DATE: 30 January 2015

SUBJECT: Review of Stability Issues
Hyland Facility Associates
Town of Angelica,
Allegany County, New York

Background

The issue pertains to the placement of drill cuttings (derived from Marcellus Shale industry wastes), sludges, liquids, and other drilling industry wastes in the Hyland landfill facility, located in the town of Angelica, in Allegany County, New York. The landfill was originally permitted to operate as an incinerator ash monofill, for the disposal of ash from municipal solid waste incinerators.

A review of the hearings and decisions pertaining to the permitting of this site indicates that several engineering issues were discussed during the permit process. Placement of drill cuttings and other drilling industry wastes in this landfill would raise serious concerns regarding several factors. Significant issues would also appear if liquid wastes were to be placed in the landfill in amounts which were not accounted for in the design phase.

Slope Stability

The ALJ's decision on the permit application from 1995 mentions that the slope stability issue "has to do with the question of whether the landfill and the materials on which it would be built can support the weight of the landfill without collapsing, sliding

or otherwise failing." There are two critical areas where the slope stability might be adversely affected.

Increase in density of waste

The landfill was considered as an ash monofill during the original permitting. Any change in the contents of the landfill subsequent to permitting, would alter the loads applied by the landfill on the subsurface below. Specifically, when a denser material (than what was considered in design) is placed in the landfill, it adds more load on the landfill. Increase in load causes the slope stability factor of safety to decrease, indicating a more critical condition with respect to stability.

Slope stability analyses of landfills take into account different cases of failures, both through the waste mass and through the subsurface below the landfill. Significant questions regarding stability were raised during the permitting process regarding the nature of the subsurface material at the site (based on review of hearings and decisions). The issues included:

- Well logs indicated presence of some soils which tend to liquefy or get loose when disturbed
- Question as to whether the subgrade should be treated as one material or multiple materials
- The nature of consolidation of the subgrade, when it is subjected to load
- Presence of soils with very low blow count (as per Standard Penetration Test, SPT), which usually indicates loose or soft deposits
- Possible presence of artesian pressure below the landfill

Any increase in the density of the material disposed of in the landfill would have significant adverse impact on slope stability. I am reliably informed that drill cuttings at this site can be four times as dense as conventional municipal and industrial waste. In that case, new analyses must be conducted to ascertain the nature of the impact this denser material has on slope stability.

Increase of pore water pressure within the landfill

The disposal of liquid, as well as recirculation of leachate, would cause pore water pressure within the landfill to be elevated. When loads are applied at rates that are faster than the rates at which the pore water pressures can dissipate, an "undrained" condition results. This condition can have adverse effects on slope stability.

Reports filed by NYSDEC on-site monitor for at least the last two years indicate chronic side seeps and other leaks of leachate from the subject landfill. Leachate seeps from side slopes indicate elevated leachate heads within the landfill. This, in turn, indicates the existence of elevated pore water pressures, which can cause instability.

Introduction of liquids without considering adverse consequences on slope stability have been known to result in failures of landfill slopes at other sites. The analyses completed during the permitting process must be reviewed to ascertain if conditions currently existing in the landfill had been anticipated and evaluated during design. If not, new analyses must be conducted to reflect conditions resulting from disposal of liquids and leachate recirculation.

Foundation Analysis

Disposal of waste material (such as drilling waste) which is denser than the material originally considered in design would exert additional loads on the subsurface material below the landfill. This will likely result in excessive settlement, which needs to be calculated. In addition, high load applied on a relatively weak or loose/soft subsurface material may result in shear failure through the subsurface material.

As per ALJ's ruling on the original permit application, "Applicant has not demonstrated that the proposed landfill and the soil beneath it would be stable." This issue takes on added significance when the landfill receives wastes denser than the ash, which it was originally designed for.

Conclusions

The disposal of drill cuttings and liquids may have serious adverse impact on the stability of the landfill and its foundation. Concerns about some of these items had been discussed during the permit hearings. Recent reports by the NYSDEC site monitor indicate existence of leachate seeps from side slopes, which appear to indicate elevated leachate heads within the landfill. New analyses must be conducted to evaluate stability under existing and proposed conditions, where denser drill cuttings and recirculated liquids are present in the landfill.

I was contacted shortly before the deadline for filing comments and did not have sufficient time to obtain and review engineering design reports related to the site. In the absence of specific information from the site (some of which might be contained in engineering design reports), I am unable to provide a quantitative, site-specific assessment of conditions at this time.

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