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March 6, 2023
Mr. Gregory E. Morris, P.E.
Manager - Solid Waste Unit
Bureau of Land, Division of Land Pollution Control, Permit Section
Illinois Environmental Protection Agency
1021 North Grand Avenue East
Springfield, IL 62702

Subject: **Zion Landfill Site 2 North Expansion Permit Application**
Draft Denial Received November 4, 2022
Permit No. 1995-343-LFM, Log No. 2022-254

Dear Mr. Morris:

On behalf of Zion Landfill, Inc., Aptim Environmental & Infrastructure, LLC (APTIM) is submitting this response to the Draft Denial letter recently provided by the Illinois Environmental Protection Agency (IEPA) regarding the permit application to expand Zion Landfill.

Responses to Comments

1. IEPA Comment: *Pursuant to 35 Ill. Adm. Code 811.103(a)(4), all surface water control structures must be operated until the final cover is placed and erosional stability is provided by the vegetative or other cover meeting the requirements of Section 811.205 or 811.322.*
   - *Acknowledge that all surface water control structures will be operated until the final cover is placed and erosional stability is provided by the vegetative cover.*

   Applicant Response: All surface water control structures will be operated until the final cover is placed and erosional stability is provided by the vegetative cover.

2. IEPA Comment: *Pursuant to 35 Ill. Adm. Code 811.103(a)(5), all discharge structures must be designed to have flow velocities that will not cause erosion and scouring of the natural or constructed lining, i.e., bottom and sides, of the receiving stream channel.*
   - *Provide documentation that all discharge structures are designed to have flow velocities that will not cause erosion and scouring of the natural or constructed lining of the receiving stream channel.*

   Applicant Response: In Appendix M, all stormwater conveyance features were evaluated to determine whether there is a potential for erosive flow velocities during the 100-year, 1-hour storm (peak velocity). Stormwater conveyance features with flow velocities greater than 5 feet per second (fps) were identified. Since the proposed detention basin outlet may exhibit flow velocities exceeding 5 fps during the peak modeled storm, riprap or other approved erosion control lining materials will be placed at the outlet location to reduce exit flow velocities. Design Drawing No. D12, provided within the originally submitted permit application, depicts the approximate location of riprap placement at the proposed Basin 8 outlet location.

3. IEPA Comment: *Pursuant to 35 Ill. Adm. Code 811.103(b)(2), diversion facilities must be designed to prevent runoff from the 25-year, 24-hour precipitation event from entering disturbed areas, unless the Agency has issued an RD&D permit that provides otherwise pursuant to 35 Ill. Adm. Code 813.112(a)(1), relating to run-on control systems, and that permit is in effect.*
   - *Provide documentation that diversion facilities are designed to prevent runoff from the 25-year, 24-hour precipitation event from entering disturbed areas.*

   Applicant Response: The facility perimeter stormwater management system, including all perimeter ditches, Detention Basin 8, and basin culvert inlets, will be constructed prior to waste being placed within the horizontal expansion area. The perimeter stormwater management system has been sized to accommodate peak runoff flow rates and volumes associated with the modeled 100-year storm event under post-closure conditions, as demonstrated by the calculations presented in Appendix M and summarized in Section 2.4. After the perimeter stormwater management system is constructed, all stormwater runoff in the horizontal expansion area will be handled by these perimeter features that were sized as part of the post-closure stormwater management plan.

   Temporary stormwater management facilities will also be constructed as part of the phased development of the landfill. As each cell is constructed, beginning with the southernmost cell in the horizontal expansion area (Cell 11), a cell delineation berm will be constructed along the northern boundary of the cell, and stormwater ditches with collection sumps will be constructed north of the cell delineation berm to collect stormwater within the excavated area that lies north of the cell boundary. Each of the temporary stormwater sumps can be equipped with a dewatering sump pump, so that collected stormwater may be pumped into the facility's perimeter stormwater management system during and/or after rain events. The primary intention of these stormwater ditches is to prevent stormwater from unnecessarily contacting waste, which minimizes the quantity of leachate that is generated. The applicant used HydroCAD to size the temporary stormwater ditches and their associated sumps to collect the volume of stormwater that would land within the excavated area north of the cell delineation berm during the 25-year, 24-hour storm event. This is a conservative sizing approach since the facility will be equipped to dewater the sumps during heavy rain events to mitigate the quantity of collected water. Revised Design Drawing Nos. D30-D37, provided within Attachment 1 of this submission, depict a modified temporary ditch design that has been sized as described in this response. HydroCAD outputs are provided within Attachment 1. Delineated subcatchment areas during each development phase are also presented in Figures 1-7 within Attachment 1.

   General HydroCAD modeling assumptions used in all stormwater management system analyses are provided throughout Appendix M (rainfall totals, distributions, etc.). For the purposes of this temporary ditch sizing calculation, HydroCAD was used to quantify the 25-year, 24-hour runoff volume for sump sizing. It was conservatively assumed that all stormwater enters the sumps via direct precipitation. A curve number of 94 was selected to represent a newly graded area with underlying soils exhibiting the hydrologic soil group that produces the largest quantity of runoff (HSG-D).

   During any given phase of cell construction, the area north of the constructed cells may be disturbed for operational purposes (soil stockpiling, equipment ingress/egress pathways, etc.), resulting in topographic changes north of the constructed cells. Since the existing surveyed topography shown in Drawings D30-D35 is not representative of future operational conditions, and since it will be constantly changing, and since it will be entirely contained within the raised perimeter ditch system, the applicant has not attempted to incorporate areas north of the cell excavation in the ditch sizing calculation. The applicant anticipates that stormwater runoff generated outside of each cell excavation will be directed toward low elevation areas on the north side of the horizontal expansion area to prevent additional stormwater flow toward active filling areas. These areas would be dewatered after rain events, with stormwater runoff being transferred into the perimeter stormwater management system.

Temporary terrace benches may also be installed along the operational slope of the landfill if intermediate cover has been applied to upgradient areas, as shown in Design Drawing Nos. D31-D36. These temporary terrace benches would divert stormwater from upgradient areas into temporary downchute ditches that would be graded to drain into the perimeter stormwater ditches. The applicant used HydroCAD to size the terrace berms and their associated downchutes to convey the 25-year, 24-hour runoff volume from upgradient areas without overtopping. The HydroCAD outputs are provided within Attachment 1.

As stated previously, HydroCAD modeling assumptions used in all stormwater management system analyses are provided throughout Appendix M (rainfall totals, distributions, etc.). Terrace benches were entered into HydroCAD as V-notch channels with 10H:1V and 3H:1V sideslopes. The benches are designed to be 25-ft wide, therefore, the channel depth is entered as 2.5 feet. The slopes of the terrace benches vary between approximately 0.5% and 1.5%. A Manning's number of 0.022 is chosen to represent a typical value for earth (clean and straight). Please see the HydroCAD outputs provided in Attachment 1 for verification that the terrace benches are sized to convey the 25-year, 24-hour runoff volume without overtopping. The HydroCAD model outputs additionally indicate that erosive flow velocities (>5 fps) are not anticipated.

Downchute ditches were entered into HydroCAD as channels with 8-ft bottom width, 6-inch depth, and 3H:1V sideslopes. A Manning's number of 0.022 is chosen to represent a typical value for earth (clean and straight). The downchutes are generally sloped at approximately 25%, with the exception of the temporary downchute ditches shown in Design Drawing D31, where the slope varies between approximately 18% and 6%. This downchute is modeled in segments in HydroCAD to account for slope variation. Please see the HydroCAD outputs in Attachment 1 for verification that the downchute ditches are sized to convey the 25-year, 24-hour runoff volume without overtopping. The HydroCAD model outputs additionally indicate that erosive flow velocities (>5 fps) are not anticipated during the 25-year, 24-hour storm, however, the Applicant proposes lining these downchutes with straw erosion control mats.

4. IEPA Comment: *Pursuant to 35 Ill. Adm. Code 811.103(b)(5), all diversion structures must be operated until the final cover is placed and erosional stability is provided by the vegetative or other cover that meets the requirements of Section 811.205 or 811.322.*
   - *Acknowledge that all diversion structures will be operated until the final cover is placed and erosional stability is provided by the vegetative cover.*

   Applicant Response: All proposed perimeter stormwater conveyance features presented in the originally submitted Design Drawing D13, including perimeter stormwater ditches, culverts, and Detention Basin 8, will be constructed prior to engaging in active filling activities within the horizontal expansion area. The perimeter stormwater conveyance system and facility berms are designed to prevent stormwater run-on from undisturbed areas outside the facility. These design features will be operated through final cover placement and erosional stabilization by vegetative cover. Additional temporary diversion structures will be constructed in phases to accommodate the construction of each cell, as depicted in Design Drawing Nos. D30-D37. As cells are progressively constructed and filled from south to north, new cell delineation berms and temporary stormwater collection sumps will be constructed to minimize stormwater runoff within the excavated cell (see Design Drawing Nos. D30-D37).

5. IEPA Comment: *Pursuant to 35 Ill. Adm. Code 811.306(a)(1), the applicant shall provide cross sections and plan views of the liner system. The design drawings on sheet D16 depicting the liner system differ from the description of the liner system in Section 2.3, Page 3. Design drawing D16 depicts the geosynthetic clay liner between two sheets of 60-mil HDPE geomembrane whereas the description in Section 2.3, Page 3, states that the geosynthetic clay liner is between one sheet of 60-mil HDPE geomembrane and a five foot thick compacted clay liner.*
   - *Revise the description of the composite liner system or design drawings. Also, verify that the Groundwater Impact Assessment and other calculations used the proper liner system design.*

   Applicant Response: The Applicant assumes that the IEPA intended to reference Design Drawing No. D18, which presents cross-sections of the proposed liner system within the leachate collection sumps. Design Drawing No. D18 correctly depicts the proposed sump liner system. Page 3 of Section 2.3 contained an error and has been modified to state that the composite liner system in the sump will include a geosynthetic clay liner (GCL) between two 60-mil HDPE geomembranes, underlain by a 5-ft compacted clay liner. (See Attachment 2.) All calculations in the submitted application use the proper liner system design as depicted on Design Drawing No. D18.

6. IEPA Comment: *Pursuant to 35 Ill. Adm. Code 811.309(b), the leachate management system must consist of any combination of multiple treatment and storage structures, to allow the management and disposal of leachate during routine maintenance and repairs.*
   - *Provide an explanation of how routine maintenance and repairs will not disrupt the ability to collect leachate.*

   Applicant Response: As described in the originally submitted Appendix K.9, two (2) existing 32,000-gallon leachate storage tanks will remain in place, and one (1) new 160,000-gallon leachate storage tank will be installed north of the proposed expansion area. When one tank undergoes routine maintenance or repairs, the other two (2) tanks will be available for leachate storage. As shown in the calculations provided in Appendix K.9, the capacity of each individual tank exceeds the required five days' worth of leachate storage capacity.

7. IEPA Comment: *Pursuant to 35 Ill. Adm. Code 811.309(d)(3), leachate storage systems must be fabricated from material compatible with the leachate expected to be generated and resistant to temperature extremes.*
   - *Provide an explanation of how the materials used will be compatible with extreme temperatures.*

   Applicant Response: Two (2) existing permitted leachate storage tanks will remain in use. The Applicant will ensure that the proposed additional 160,000-gallon leachate storage tank is manufactured to be chemically compatible with landfill leachate. The Applicant will also ensure that the leachate storage systems are equipped with proper heating, stirring, and/or insulation systems to prevent leachate from freezing during winter months, and ensure that the leachate tanks are rated by the manufacturer to withstand the expected local high temperatures during summer months.

8. IEPA Comment: *Pursuant to 35 Ill. Adm. Code 811.309(d)(4), the leachate storage system must not cause or contribute to a malodor.*
   - *Provide an explanation of how the leachate storage system will not cause or contribute to a malodor.*

Applicant Response: The leachate storage tanks will be fully enclosed save for lid vents which are required for safety. Similar tanks have been utilized at the permitted landfill without issue. Stored leachate will not be exposed to the open air. Additionally, an Odor Control Plan was submitted within the original permit application. (See Exhibit 5 of the originally submitted Appendix R.) The Odor Control Plan describes the Applicant's plan to prevent, monitor, and address potential odor issues.

9. IEPA Comment: *Pursuant to 35 Ill. Adm. Code 811.310(b)(1), gas monitoring devices must be placed at intervals and elevations within the waste to provide a representative sampling of the composition and buildup of gases within the unit.*
   - *Provide documentation that all gas monitoring devices will be placed at intervals and elevations within the waste to provide a representative sampling of the composition and buildup of gases within the unit.*

   Applicant Response: All gas monitoring wells will be placed at intervals and elevations within the waste to provide a representative sampling of the composition and buildup of gases within the unit. Detail No. 4 within Design Drawing No. D20 depicts a typical gas extraction well with the PVC screen placed above the elevation at which waste is saturated. The distance between each gas monitoring device will be dependent upon determination of the radius of influence of the wells. As described in Section 5.1.3 of the US EPA Guidance for Evaluating Landfill Gas Emissions from Closed or Abandoned Facilities, provided for reference as Attachment 3, determination of well spacing is most effectively accomplished using field data.

   The conceptual landfill gas management system depicted in Design Drawing No. D14 is designed with well spacing equal to that at the existing facility. The existing system has been designed to be consistent with the guidance document which recommends placing wells within the waste boundary along the perimeter of the landfill, no more than the radius of influence from the perimeter, with no more than two times the radius of influence between wells. This existing system has been empirically observed to be effectively collecting landfill gas. Because the proposed expansion will be comprised of the same waste stream and will have similar geometry as the existing facility, a gas collection system with a tighter spacing as depicted in Drawing No. D14 will be adequate for the Site 2 North Expansion. This system will be installed in phases, each of which will be approved by the IEPA. Collection of field data will be conducted to verify that this well spacing is adequate for the Site 2 North Expansion area or whether modifications are necessary as filing progresses. A revised Design Drawing No. D14 showing the estimated radius of influence of 150 ft surrounding each proposed landfill gas extraction well has been provided as Attachment 4 of this submittal.

10. IEPA Comment: *Pursuant to 35 Ill. Adm. Code 811.310(d)(2), ambient air monitors must be sampled for methane only when the average wind velocity is less than five miles per hour at a minimum of three downwind locations 100 feet from the edge of the unit or the property boundary, whichever is closer to the unit.*
    - *Acknowledge that the maximum wind speed at which samples are taken will be five miles per hour.*

    Applicant Response: The Applicant acknowledges that ambient air monitors will be sampled for methane only when the average wind velocity is less than five miles per hour at a minimum of three downwind locations 100 feet from the edge of the unit or the property boundary, whichever is closer to the unit.

11. IEPA Comment: *Pursuant to 35 Ill. Adm. Code 811.311(b)(1), if methane gas levels exceed the limits specified in subsections (a)(1) or (a)(2), an owner or operator of a MSWLF unit shall notify the Agency in writing, within two business days of an observed exceedance.*
    - *Acknowledge that if methane gas levels exceed the limits specified in subsections (a)(1) or (a)(2), an owner or operator of a MSWLF unit will notify the Agency in writing, within two business days of an observed exceedance.*

    Applicant Response: The Applicant acknowledges that if methane gas levels exceed the limits specified in subsections (a)(1) or (a)(2) of 35 Ill. Adm. Code 811.311, the owner or operator of Zion Landfill will notify the Agency in writing within two business days of the observed exceedance.

12. IEPA Comment: *Pursuant to 35 Ill. Adm. Code 811.311(b)(2), if methane gas levels exceed the limits specified in subsections (a)(1) or (a)(2), an owner or operator of a MSWLF unit shall implement the requirements of this Section to ensure the protection of human health.*
    - *Provide documentation that if methane gas levels exceed the limits specified in subsections (a)(1) or (a)(2), an owner or operator of a MSWLF unit will implement the requirements of this Section to ensure the protection of human health.*

    Applicant Response: The Applicant acknowledges that if methane gas levels exceed the limits specified in subsections (a)(1) or (a)(2) of 35 Ill. Adm. Code 811.311, the owner or operator of Zion Landfill will implement the requirements of the referenced Section to ensure the protection of human health.

13. IEPA Comment: *Pursuant to 35 Ill. Adm. Code 811.311(d)(5), all materials and equipment used in construction of the system shall be rated by the manufacturer as safe for use in hazardous or explosive environments and shall be resistant to corrosion by constituents of the landfill gas.*
    - *Provide documentation that all materials and equipment used in construction of the system shall be rated by the manufacturer as safe for use in hazardous or explosive environments.*

    Applicant Response: The Applicant acknowledges that all materials and equipment used in construction of the gas collection system shall be rated by the manufacturer as safe for use in hazardous or explosive environments.

14. IEPA Comment: *Pursuant to 35 Ill. Adm. Code 811.311(d)(10), the portion of the gas collection system used to convey the gas collected from one or more units for processing and disposal shall be tested to be airtight to prevent the leaking of gas from the collection system or entry of air into the system.*
    - *Provide an explanation of how the system will be tested to be airtight.*

    Applicant Response: Page 64 of the CQA Plan states that landfill gas pipes shall be pressure tested at 5 psi for 60 minutes. Table 13 of the CQA Plan states that the observed pressure drop must be no greater than 5%. (See Appendix O of the originally submitted permit application). Conveyance piping is generally operated in a vacuum, which will be tested for oxygen in order to detect any air intrusion into the system.

15. IEPA Comment: *Pursuant to 35 Ill. Adm. Code 811.312(d), representative flow rate measurements shall be made of gas flow into treatment or combustion devices.*
    - *Provide an explanation of how representative flow rate measurements shall be made of gas flow into treatment or combustion devices.*

Applicant Response: The existing landfill gas collection system is equipped with a flow meter to allow for gas flow rate measurements. The Applicant will continue to monitor gas flow rates with a flow meter.

16. IEPA Comment: *Pursuant to 35 Ill. Adm. Code 811.312(e), when used for the onsite combustion of landfill gas, flares shall meet the general control device requirements of new source performance standards adopted pursuant to Section 9.1(b) of the Act.*
    - *Provide documentation that flares shall meet the general control device requirements of new source performance standards adopted pursuant to Section 9.1(b) of the Act.*

    Applicant Response: The Applicant acknowledges that flares used at the facility shall meet the general control device requirements of new source performance standards adopted pursuant to Section 9.1(b) of the Act. Zion Landfill maintains a facility air permit and obtains air construction permits for modifications or expansions of the landfill gas collection system. As part of facility air permit requirements, Zion Landfill maintains an NSPS Landfill Gas Collection and Control System Design Plan, which identifies pertinent NSPS regulations and presents the facility's implementation of those regulations, including NSPS performance testing of the facility's flare system. If a new flare is installed at the facility, it will be evaluated for NSPS compliance, as required by the facility's air permit. The current Clean Air Act Permit Program (CAAPP) Permit No. 97030064 is provided as Attachment 9 of this submission. The applicant notes that an application for renewal of this permit was submitted to the IEPA on September 19, 2019. Although the expiration date of the current CAAPP Permit was June 24, 2020, Zion Landfill met the deadline for the required permit renewal submission, and the existing permit is valid until permit renewal is issued by the IEPA.

17. IEPA Comment: *Pursuant to 35 Ill. Adm. Code 811.314(b)(3)(A)(iii), alternative specifications may be utilized provided that the performance of the low permeability layer is equal to or superior to the performance of a layer meeting the requirements of subsections (b)(3)(A)(i) and (b)(3)(A)(ii).*
    - *Demonstrate that the proposed low permeability layer in the final cover is equal to or superior to a traditional three-foot thick compacted clay liner.*

    Applicant Response: In Appendix K.11 of the application, a HELP model analysis was conducted to demonstrate that the proposed low permeability layer in the final cover is superior to a traditional three-foot thick compacted clay liner. HELP models were developed to represent both final cover scenarios to allow for comparison of leachate percolation.

18. IEPA Comment: *Pursuant to 35 Ill. Adm. Code 811.314(c)(3), the final protective layer must consist of soil material capable of supporting vegetation.*
    - *Acknowledge that all three (3) feet of the final protective layer soil will be capable of supporting vegetation.*

    Applicant Response: Based on the Applicant's professional experience with landfill development in Illinois, it is the Applicant's understanding that 35 Ill. Adm. Code 811.314(c)(3) does not require that all three (3) feet of the final protective layer should be capable of supporting vegetation. The Applicant's understanding is that the intent of this regulation is to ensure that the final cover is compatible with vegetative growth. Based on professional experience, the Applicant is confident that the proposed six inches of topsoil is adequate to maintain the type of vegetation that will be planted on the landfill final cover. Furthermore, as described in subsections (c)(2) and (c)(4) of the referenced 35 Ill. Adm. Code 811.314, the Applicant understands that the primary intention of the final protective layer is not only to support vegetation, but also to protect the low permeability layer from freezing, minimize root penetration of the low permeability layer, and prevent desiccation, cracking, freezing, or other damage to the low permeability layer. In order to incorporate all of these regulatory expectations, including the requirement that the final protective layer must be thick enough to minimize root penetration, it is not practical to use material capable of supporting vegetation throughout the entire final protective layer.

19. IEPA Comment: *Pursuant to 35 Ill. Adm. Code 811.321(a)(1), waste disposal operations must move from the lowest portions of the unit to the highest portions. Except as provided in subsection (a)(2), the placement of waste must begin in the lowest part of the active face of the unit, located in the part of the facility most downgradient, with respect to groundwater flow.*
    - *Provide a description of waste placement in each cell to demonstrate that the placement of waste disposal operations will move from the lowest portions of the unit to the highest portions, beginning in the part of the facility most downgradient.*

    Applicant Response: Between February 2019 and February 2021, the potentiometric maps indicated that groundwater flows predominantly to the east, with some northerly flow. However, it is variable.

    The applicant anticipates that each cell will be constructed in its entirety prior to waste placement, as presented in the landfill phasing drawings (Design Drawings Nos. D30-D37). Downgradient wells will be installed sequentially as cells are constructed, as shown in the proposed groundwater monitoring plan in Design Drawing No. D12. Waste placement will begin at the lowest point within each cell, where the leachate collection sumps are located, along the western border of the horizontal expansion area. The leachate collection sumps are proposed to be located on the western end of the cells out of necessity, to allow for leachate collection piping tie-in to the existing facility and ease of connection to the leachate loadout facilities. This configuration additionally creates less of a public nuisance, as most internal vehicular traffic and operations will occur on the west side of the landfill near the adjacent golf course, as opposed to the east side of the landfill adjacent to Kenosha Road.

    There are a few reasons why the horizontal expansion area must be constructed from south to north as shown in the phasing plan (Design Drawing Nos. D30-D37). Most importantly, liner tie-in procedures require each new cell to adjoin with the existing landfill. It would be impractical and detrimental to the integrity of the liner system to begin cell construction in any area that does not allow for sequential continuation of the liner system into each new cell. Beginning construction adjacent to the existing landfill also allows for sequential installation of adjoining segments of the landfill gas collection system and the leachate collection system. These systems are constructed in segments to accommodate each phase of landfill development, and each segment must be connected to the rest of the collection system in order to function as designed.

20. IEPA Comment: *Pursuant to 35 Ill. Adm. Code 811.322(b), all slopes shall be designed to drain runoff away from the cover and which prevents ponding. No standing water shall be allowed anywhere in or on the unit.*
    - *Demonstrate that all slopes shall be designed to drain runoff away from the cover and prevent ponding.*

    Applicant Response: Section 2.4, Appendix M, and Design Drawing No. D13 include a detailed presentation and analysis of the stormwater management plan, including several depictions of the final proposed topography of the landfill. As described in Section 2.4, the final landform will have 4H:1V sideslopes and a 10H:1V plateau area, all of which is graded to drain toward designed stormwater conveyance features. The landfill sideslopes have been designed with terrace berms that will be used to intercept stormwater sheet flow, collect runoff, and control erosion along the

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sideslopes. The terrace berms will be graded to drain toward flume pipes and downchute ditches that are designed to convey stormwater down the 4H:1V landfill sideslope into the proposed perimeter ditches. The perimeter ditches will then convey stormwater into Basin 5R or Basin 8 via culvert inlets. All of these stormwater conveyance features have been sized to accommodate the peak runoff flow rates and volumes associated with the modeled 100-year storm event, as demonstrated by the calculations presented in Appendix M. The landfill has not been designed with any depressional areas that would result in standing water. Please see Section 2.4, Appendix M, and Design Drawing No. D13.

21. IEPA Comment: *Pursuant to 35 Ill. Adm. Code 811.322(c)(4), vegetation shall consist of a diverse mix of native and introduced species that is consistent with the post-closure land use.*
    - *In addition to the information provided in Appendix O, Section 14, provide a table with the seed mix specifications.*

    Applicant Response: For all site restoration seeding, the seed mixture is proposed to be Northern Illinois Slope Mixture 7, as defined by Table 1 within Section 250 of the Illinois Department of Transportation Standard Specifications for Road and Bridge Construction. The referenced Section 250 is provided as Attachment 5.

22. IEPA Comment: *Pursuant to 35 Ill. Adm. Code 811.322(c)(5), vegetation shall be tolerant of the landfill gas expected to be generated.*
    - *Provide an explanation of how vegetation will be tolerant of the landfill gas expected to be generated.*

    Applicant Response: The proposed vegetation is similar to vegetation that has been used successfully at the existing permitted Zion Landfill and other landfills in Illinois. Based on the Applicant's professional experience, this type of vegetation will be tolerant of typical landfill conditions. The landfill gas collection system will prevent landfill gas from coming in contact with facility vegetation.

23. IEPA Comment: *Pursuant to 35 Ill. Adm. Code 811.323(d)(2), the party responsible for transporting the waste to the solid waste management facility must be responsible for the costs of proper cleanup, transportation, and disposal.*
    - *Provide documentation stating that the party responsible for transporting the waste to the solid waste management facility must be responsible for the costs of proper cleanup, transportation, and disposal.*

    Applicant Response: The Applicant acknowledges that the party responsible for transporting any identified hazardous waste to Zion Landfill must be responsible for the costs of proper cleanup, transportation, and disposal.

24. IEPA Comment: *Pursuant to 35 Ill. Adm. Code 811.504(b), the CQA sampling program shall be based upon statistical sampling techniques and shall establish and specify criteria for acceptance or rejection of materials and operations.*
    - *Revise Appendix O to include a description of the landfill gas monitoring system and flare system sampling procedures.*

    Applicant Response: Appendix O contains descriptions of the material testing methods to be used for landfill gas piping as originally submitted. A revision has not been presented, as the landfill will be required to obtain IEPA approval of the landfill gas collection system CQA specifications prior to the construction of the expansion. As required by the facility's air permit, when the landfill gas system is proposed to be modified or expanded, all design specifications of the landfill gas monitoring system are submitted to the IEPA Division of Air Pollution Control for review and approval. All landfill gas monitoring system components will be inspected in the field to verify that materials and dimensions meet the most updated design specifications approved by the IEPA, and the flare will be tested to ensure that it is operating in accordance with NSPS requirements. Prior to each stage of landfill gas monitoring system expansion, detailed landfill gas monitoring system installation, start-up, and monitoring procedures will be provided to the IEPA Division of Air Pollution Control for approval. Section 17 of the CQA Plan has been modified to state that Zion Landfill will obtain IEPA Division of Air Pollution Control approval of CQA specifications for landfill gas collection system construction, installation, and monitoring procedures, and that Zion Landfill will verify that the system is operating in compliance with the requirements of the facility's approved air permit prior to system start-up. Please see the revised Section 17 of the CQA Plan, provided as Attachment 6.

25. IEPA Comment: *Pursuant to 35 Ill. Adm. Code 811.704(f), the cost estimate must, at a minimum, include all costs for all activities necessary to close the facility in accordance with all requirements of this Part.*
    - *Revise the cost estimate to include quotes for the cost of equipment decontamination and the certificate of closure.*

    Applicant Response: Equipment decontamination costs are incorporated in the "Mobilizations" line item within Table 1 of the originally submitted Appendix S - Closure and Post-Closure Plan. An estimated lump sum of $20,000 has been added to the premature closure cost estimate to account for closure certification costs, based on the applicant's prior facility closure experience. A revised version of Appendix S is provided within Attachment 7 of this submission.

26. IEPA Comment: *Pursuant to 35 Ill. Adm. Code 811.305(b), all trees, stumps, roots, boulders, and debris shall be removed from the foundation.*
    - *Acknowledge that all trees, stumps, roots, boulders, and debris shall be removed from the foundation before constructing the liner.*

    Applicant Response: The Applicant acknowledges that all trees, stumps, roots, boulders, and debris shall be removed from the foundation before constructing the liner.

27. IEPA Comment: *Pursuant to 35 Ill. Adm. Code 812.306(a)(3)(B), the application shall contain information to show that the design of the liner system meets the minimum requirements of 35 Ill. Adm. Code 811.306, including a detailed description of the test liner constructed in accordance with 35 Ill. Adm. Code 811.507(a), if constructed prior to permit application.*
    - *Provide documentation of the constructed test liner, including field and laboratory testing results.*

    Applicant Response: The most recently constructed Site 2 East Expansion base liner system has been constructed in its entirety with approved CQA documentation. CQA construction documentation summary tables are provided within Attachment 8 of this submission. The Site 2 East Expansion base liner system was constructed using locally available Wadsworth formation soils, the same material that is proposed to be used in the Site 2 North Expansion. These CQA testing results indicate that the proposed liner system meets all applicable regulatory criteria, and that the proposed liner system has historically performed successfully at this facility. Therefore, a new test liner is not necessary, due to the continued use of material used and approved for use at the permitted landfill.

28. IEPA Comment: *Pursuant to 35 Ill. Adm. Code 812.306(a)(4), the application shall contain information to show that the design of the liner system meets the minimum requirements of 35 Ill. Adm. Code 811.306, including a description of construction methods and equipment to be utilized.*
    - *Provide a narrative describing the construction of the liner system and the anticipated equipment used for each step in the process.*

    Applicant Response: The composite liner system will consist of the following layers, in order of construction (bottom to top), as depicted in the originally submitted Design Drawing No. D15:

    Low-Permeability Earth Liner: The low permeability earth liner will consist of a minimum 5-foot layer of compacted cohesive soil with a maximum hydraulic conductivity of 1 x 10^{-7} cm/sec. It is anticipated that the earth liner will be constructed of Wadsworth formation soils due to the favorable physical properties for construction and low hydraulic conductivity. A detailed description of the earth liner construction process and the associated specifications was provided within Section 8 of the CQA Plan within Appendix O. The contractor will place the compacted earth liner material in lifts, as specified in Appendix O. Section 8.1 of Appendix O specifies that loose lift thicknesses for low-permeability soil compaction will not exceed 9 inches, or the thickness of the compactor foot. If soil is deposited in thicknesses exceeding 9 inches, dozers will be used to spread the soil to a 9-inch thickness prior to compaction. The compactor used for liner construction should be similar to the compactor that was used to construct the previously constructed liner system. Section 8.2 of Appendix O specifies that acceptance criteria for field density and moisture content of the low-permeability earth liner will require soil compaction to a minimum of 95% of the Standard Proctor maximum dry density, or to a minimum of 90% of the Modified Proctor maximum dry density, at a moisture content equal to or greater than optimum. The CQA Officer will verify that the low-permeability earth liner meets all specifications in the CQA Plan. Further detail describing construction and CQA procedures for the low-permeability earth liner is provided in Section 8 of the originally submitted Appendix O.

    Geomembrane: A 60-mil HDPE textured geomembrane is proposed. A detailed description of the geomembrane installation process and the associated specifications are provided within Section 11 of the CQA Plan within Appendix O, including procedures and specifications for pre-installation quality control and handling, installation, defect repair, and field seaming. Tables 1 and 2 within Appendix O provide a summary of the specifications for material acceptance and seam testing. Please see the referenced Section 11 and Tables 1 and 2.

    12-ounce Geotextile: A 12-ounce geotextile cushion is proposed to be placed over the geomembrane liner prior to placement of the leachate drainage layer. A detailed description of the geotextile installation process and the associated specifications are provided within Section 12 of the CQA Plan within Appendix O, including procedures and specifications for pre-installation quality control and handling, installation, and post-installation examination and soil placement. Tables 5 and 8 within Appendix O provide a summary of the specifications for material acceptance and testing. Please see the referenced Section 12 and Tables 5 and 8.

    Granular Drainage Layer: A 12-inch granular drainage layer will be used for transmission of leachate and structural support of the leachate collection pipes. A detailed description of the granular drainage layer installation process and the associated specifications are provided within Section 10 of Appendix O, including installation procedures, sampling requirements, acceptance criteria, and surveying. Please see the referenced Section 10.

    8-ounce Geotextile: An 8-ounce geotextile filter is proposed to be placed on top of the leachate drainage layer. A detailed description of the geotextile installation process and the associated specifications are provided within Section 12 of the CQA Plan within Appendix O, including procedures and specifications for pre-installation quality control and handling, installation, and post-installation examination and soil placement. Tables 5 and 7 within Appendix O provide a summary of the specifications for material acceptance and testing. Please see the referenced Section 12 and Tables 5 and 7.

29. IEPA Comment: *Pursuant to 35 Ill. Adm. Code 812.310(c), the application shall contain a description of and specifications for all machinery, compressors, flares, piping, and other appurtenances necessary to the system.*
    - *Provide a design drawing and specifications of the current flare system in use.*

    Applicant Response: The design drawings and specifications for the existing flare system are provided as Attachment 9 of this submission.

30. IEPA Comment: *Pursuant to 35 Ill. Adm. Code 812.311(a), a permit application should contain the approved air discharge permit or, if the permit is pending, a copy of the air discharge permit application required pursuant to 35 Ill. Adm. Code 200 thru 245.*
    - *Provide a copy of the air discharge permit.*

    Applicant Response: The current Clean Air Act Permit Program (CAAPP) Permit No. 97030064 is provided as Attachment 10 of this submission. The applicant notes that an application for renewal of this permit was submitted to the IEPA on September 19, 2019. Although the expiration date of the current CAAPP Permit was June 24, 2020, Zion Landfill met the deadline for the required permit renewal submission, and the existing permit is valid until permit renewal is issued by the IEPA.

    In addition to the CAAPP Permit, the landfill will have to obtain a new air permit from IEPA in order to construct this expansion.

31. IEPA Comment: *Pursuant to 35 Ill. Adm. Code 812.312(a), the application shall contain a description of the material to be used as intermediate cover in accordance with 35 Ill. Adm. Code 811.313, including a description of the soil to be used, including its classification and approximate hydraulic conductivity.*
    - *Provide the classification and approximate hydraulic conductivity of the soil planned to be used for intermediate cover.*

    Applicant Response: It is anticipated that locally available Wadsworth formation soils classified as silty clay will be used as intermediate cover material. Appendix I provides additional characteristics of this material, including grain size, Atterberg limits, hydraulic conductivity test data, and triaxial shear strength test data. The soil available as intermediate cover has the capability of being compacted to a hydraulic conductivity of 1×10^{-5} cm/sec. The hydraulic conductivity of the soil used for intermediate cover is subject to change based on the availability of cover materials.

32. IEPA Comment: *Pursuant to 35 Ill. Adm. Code 812.313(f), a construction quality assurance program, pursuant to 35 Ill. Adm. Code 811.Subpart E, which provides that the cover is constructed in compliance with all applicable requirements of 35 Ill. Adm. Code 811.*
    - *Provide a sampling program and criteria to accept or reject seed used in the construction of the final cover.*

Applicant Response: The facility will source the proposed seed mixture (Northern Illinois Slope Mix 7) from a vendor that supplies IDOT seed mixtures. Upon receipt, the facility will verify that the correct slope mixture was delivered.

33. IEPA Comment: *Appendix O, Page 45, states that laboratory samples will be 12 inches wide and 42 inches long. The third bullet point states that a 14 inch by 18 inch sample will be used.*
    - *Revise the sample size in the third bullet (12 inch by 14 inch).*

    Applicant Response: A revised version of the CQA Plan including the referenced correction is provided as Attachment 6.

34. IEPA Comment: Appendix Q, Section 5, Page 1, states that there are seven (7) basic steps. Only six (6) steps are listed.
    - Are there only six (6) steps or is a step missing from the list?

    Applicant Response: The six (6) listed steps encompass the procedures for collecting representative samples from groundwater or leachate monitoring wells. No steps are missing from the list. A revised version of Appendix Q which corrects this error is provided as Attachment 11.

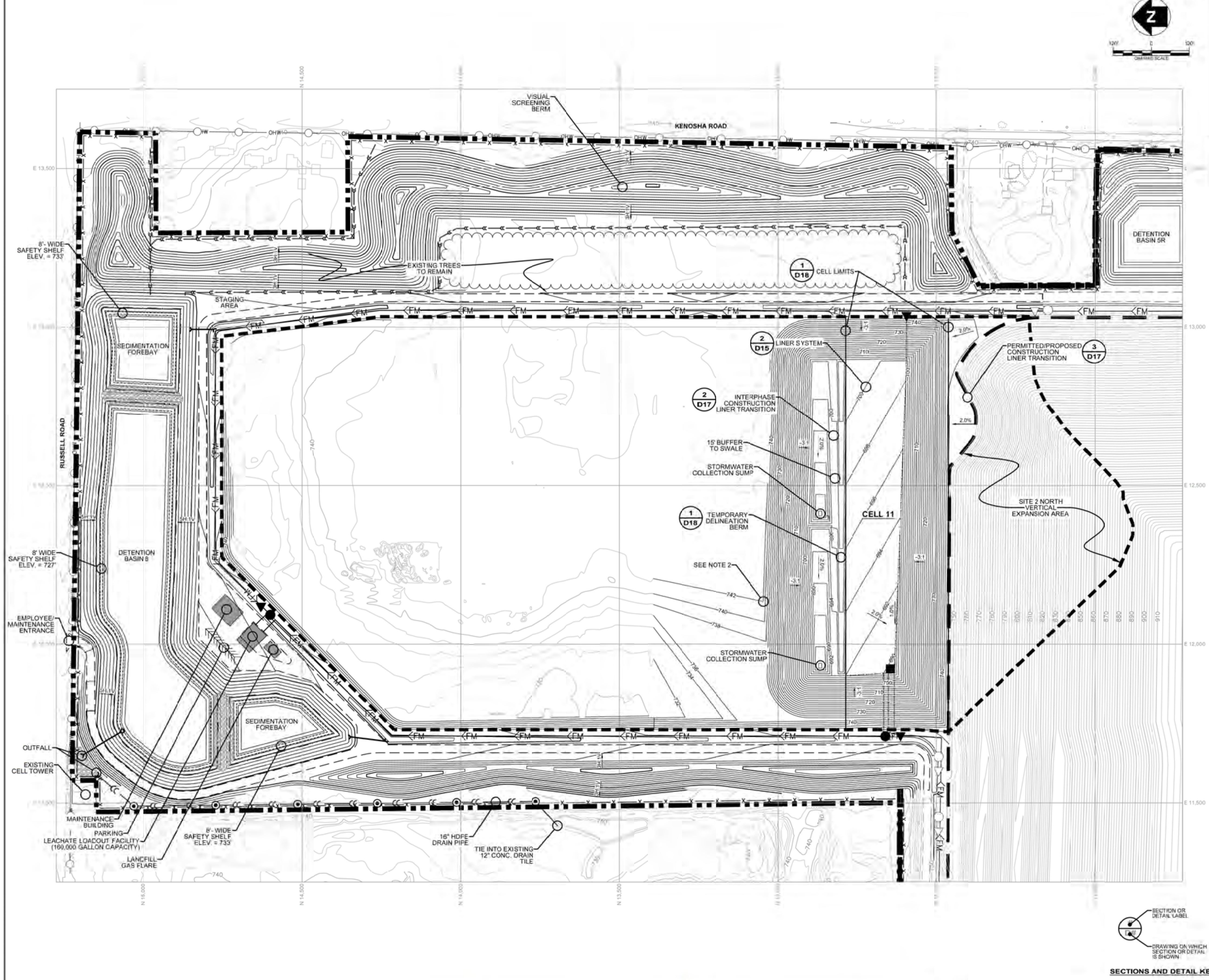
We are hopeful that the Illinois Environmental Protection Agency (IEPA) will find that this response is sufficient to address the Draft Denial Letter, and we look forward to the IEPA's continued review of the permit application. If you have any questions, please do not hesitate to contact me at (630) 762-3322.

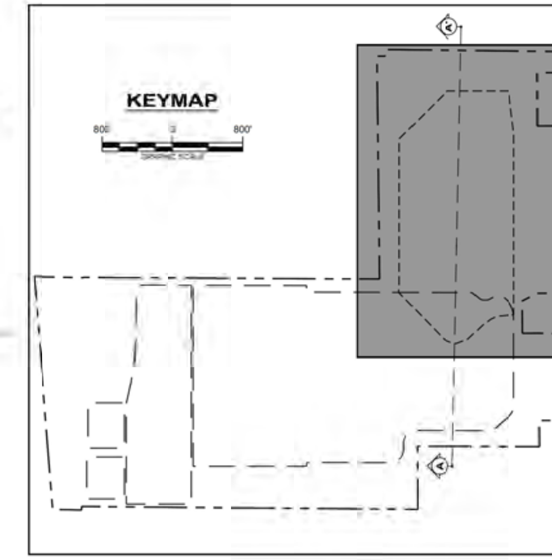
Sincerely,
Aptim Environmental & Infrastructure, LLC

Martin N. Fallon
Project Manager

ATTACHMENT 1
Temporary Stormwater Conveyance Feature Analysis

Revised Landfill Phasing Plan
Design Drawing Nos. D30-D37





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APTIM Environmental & Infrastructure, LLC

ZION LANDFILL - SITE 2 NORTH EXPANSION
CITY OF ZION, ILLINOIS

LANDFILL PHASING PLAN
PHASE A

PROJ. NO.: 631020105	DATE: DECEMBER 2022
DESIGNED BY: DAM/BWM/KM	DRAWING NO.
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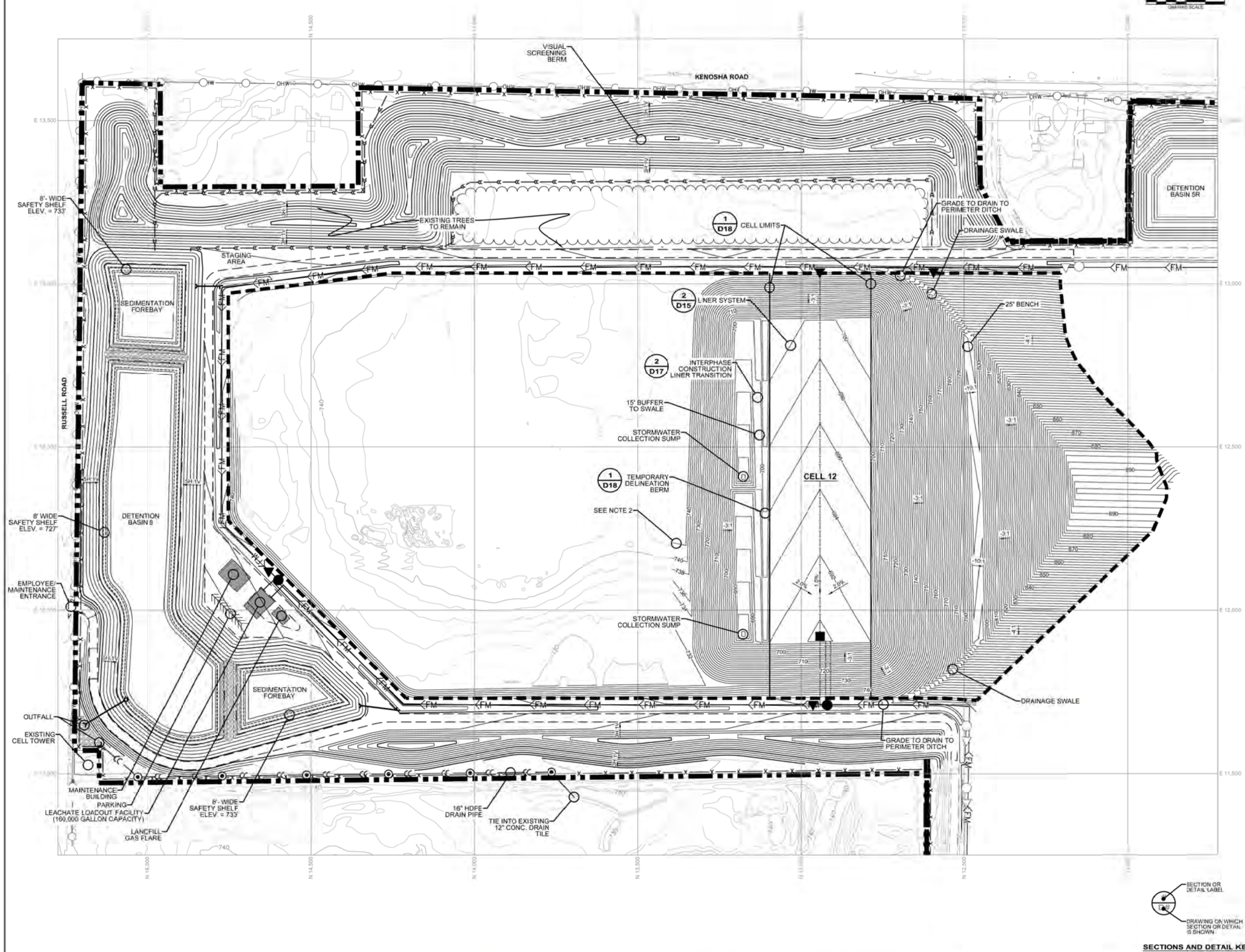

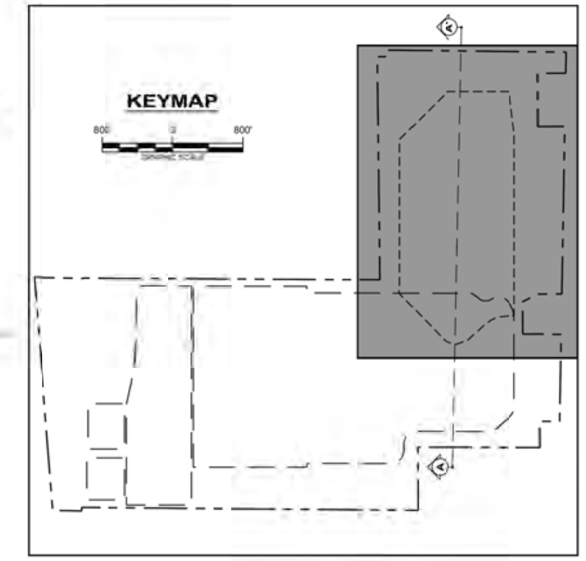

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LANDFILL PHASING PLAN
PHASE B

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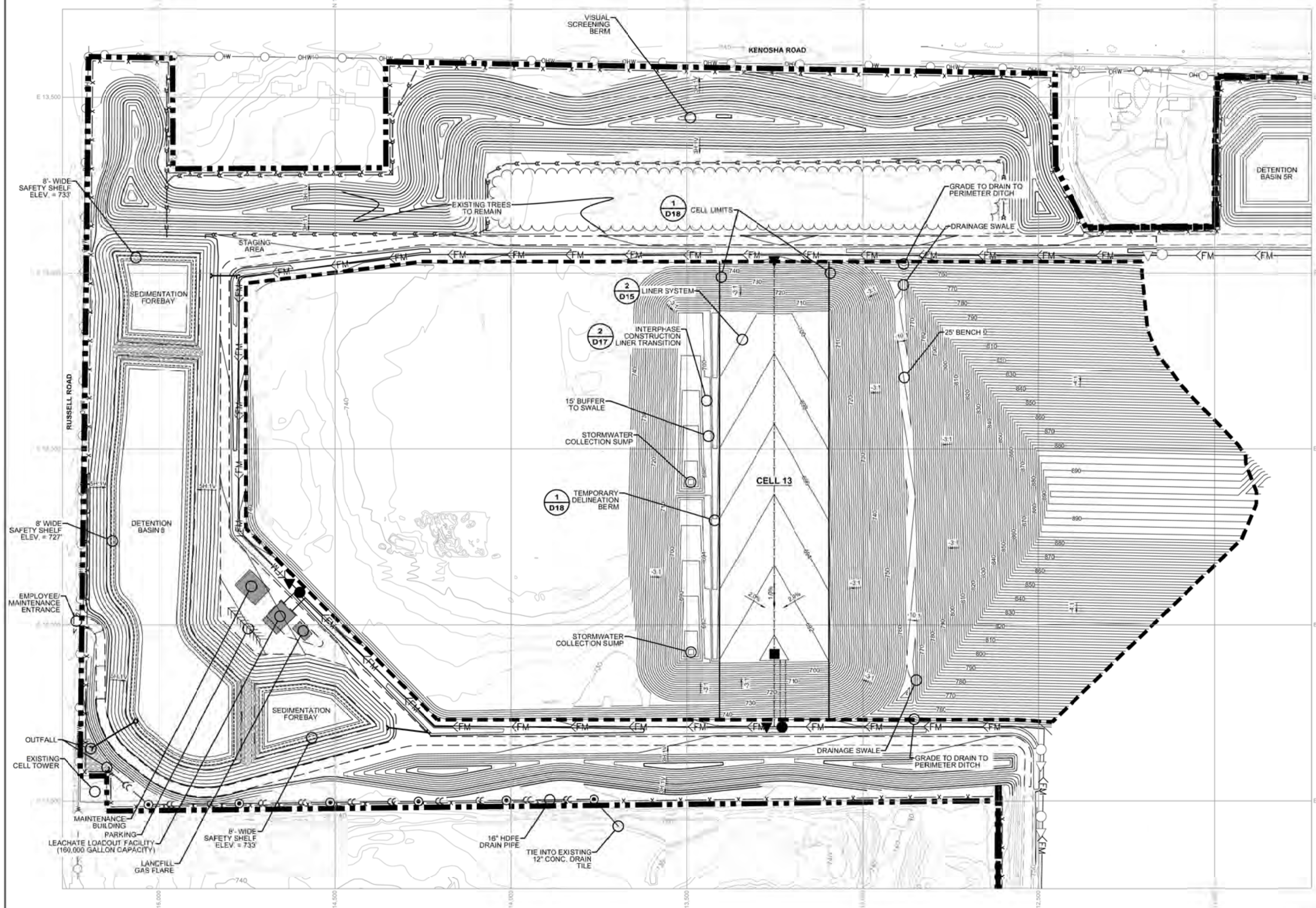

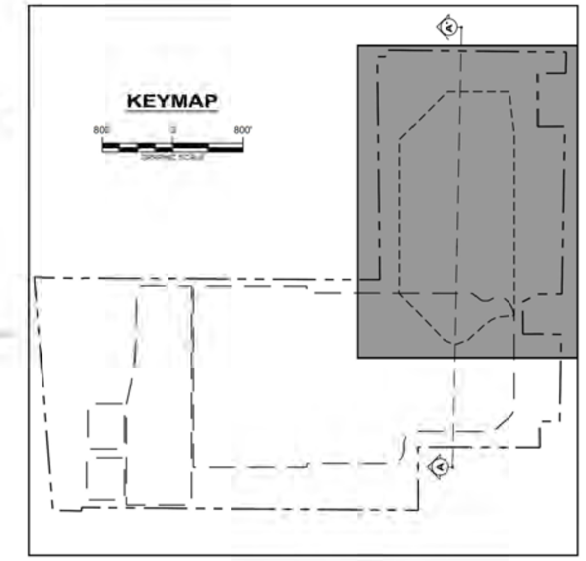

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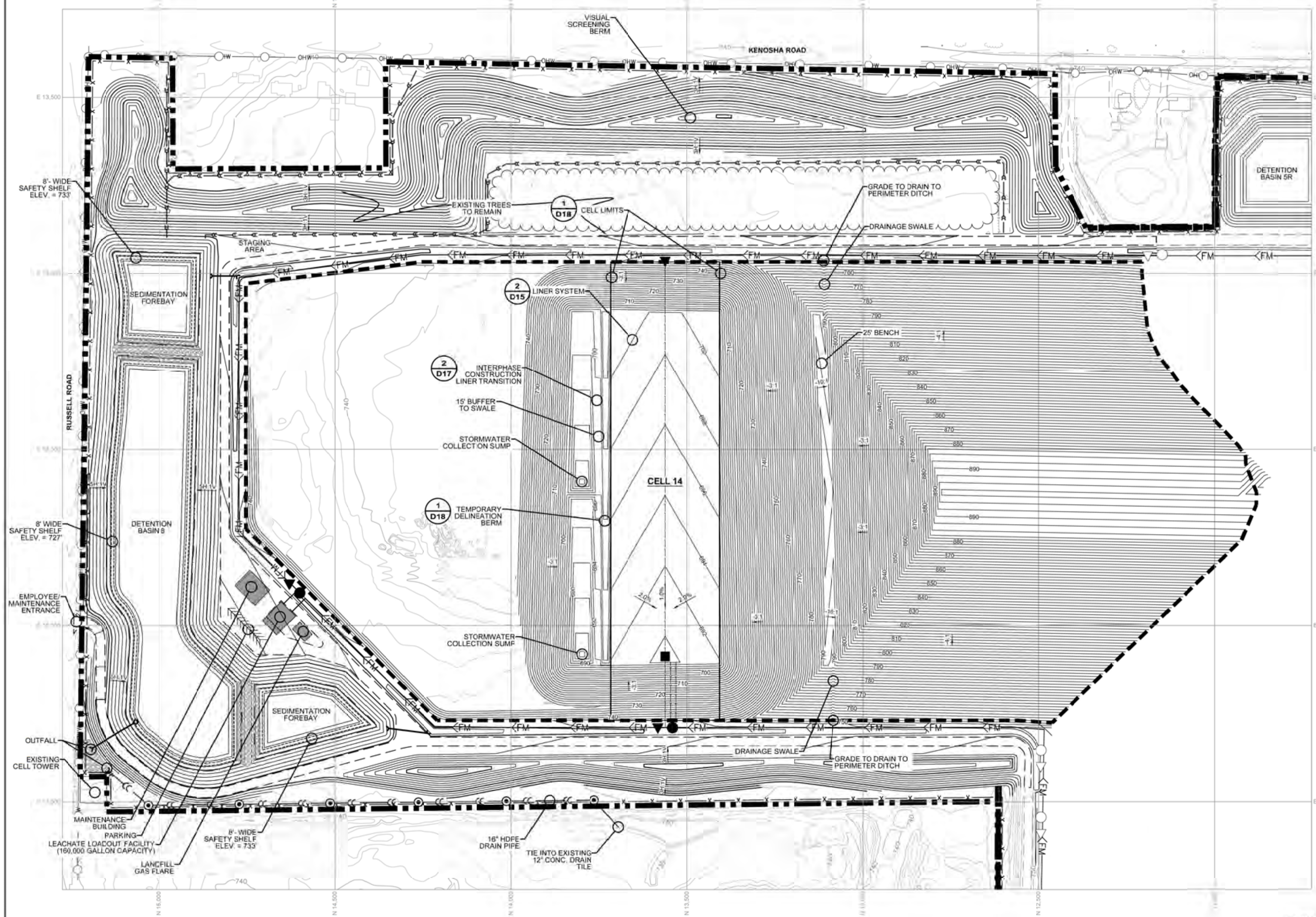

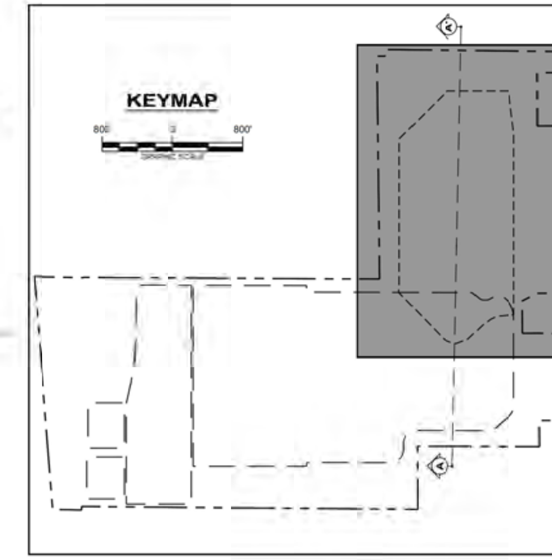

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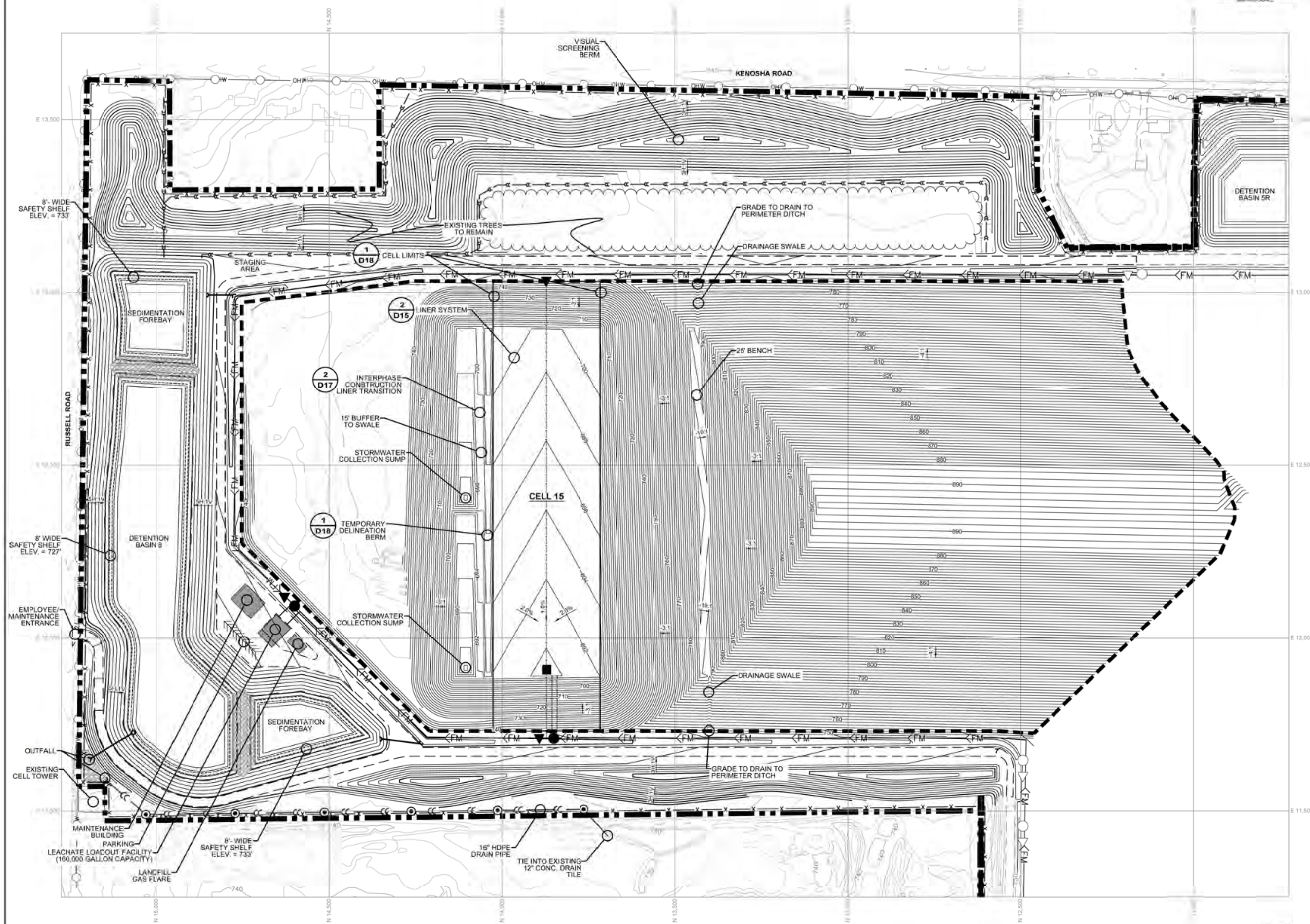

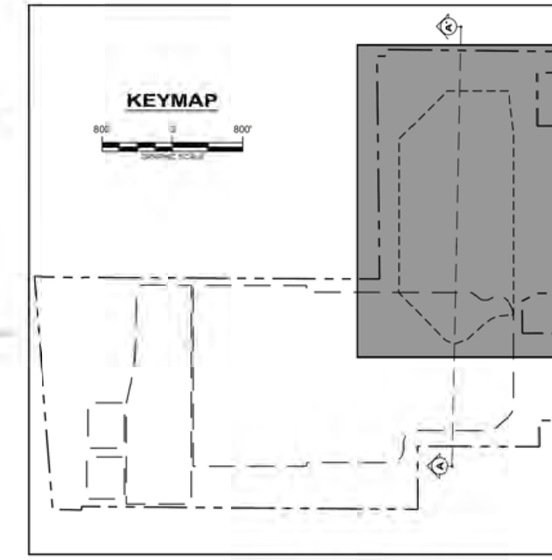

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GFL GREEN FOR LIFE environmental

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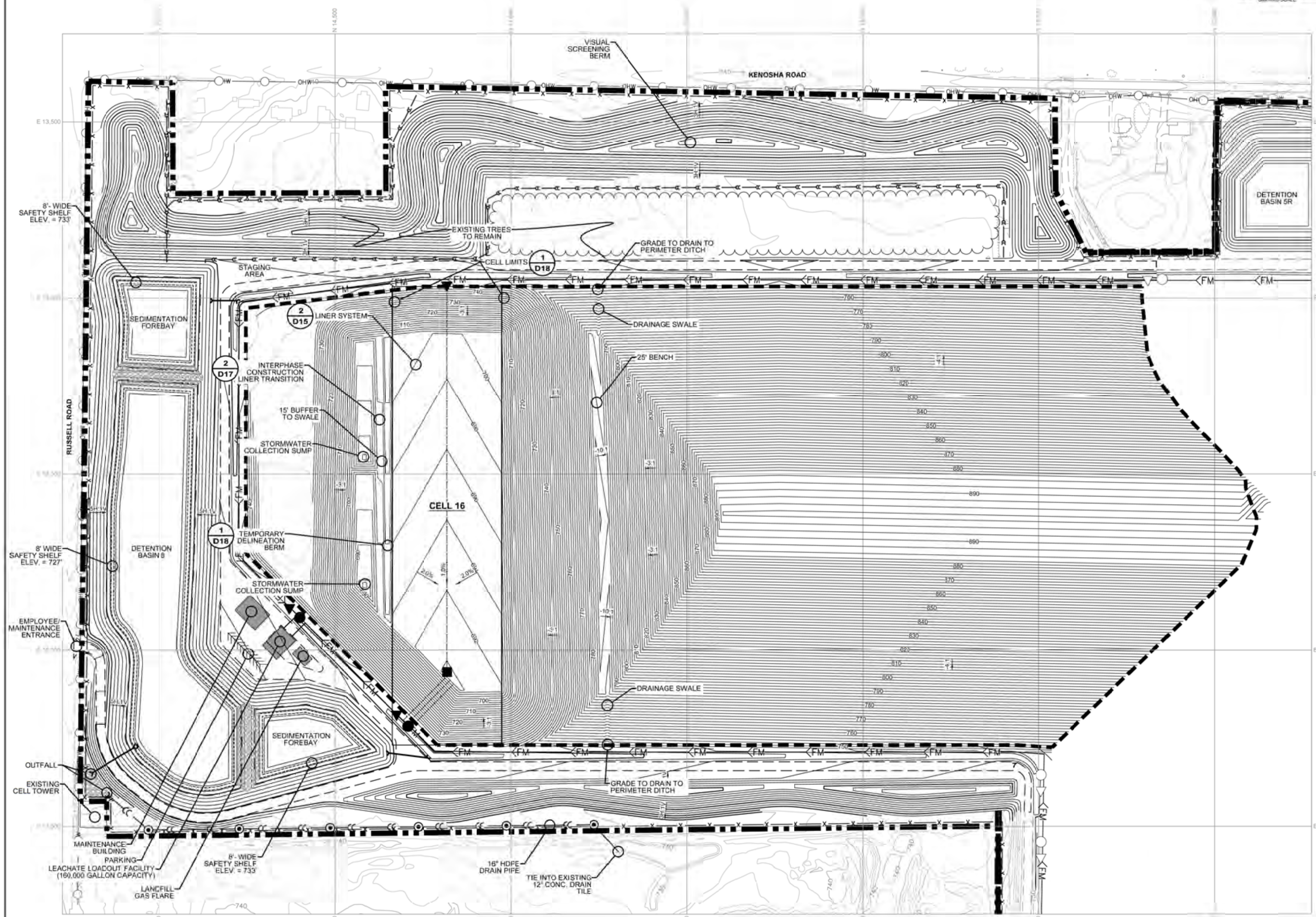
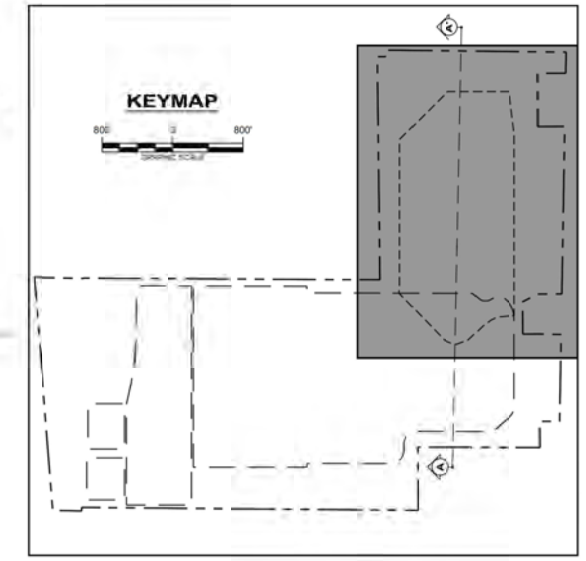
ZION LANDFILL - SITE 2 NORTH EXPANSION
CITY OF ZION, ILLINOIS

LANDFILL PHASING PLAN
PHASE E

PROJ. NO.: 631020105	DATE: DECEMBER 2022
DESIGNED BY: DAM/BWM/KM	DRAWING NO.
DRAWN BY: BWM/NV/KM	**D34**
CHECKED BY: DAM	
APPROVED BY: DAM	34 OF 37 SHEETS





LEGEND

- APPROXIMATE FACILITY BOUNDARY
- APPROXIMATE EXISTING WASTE BOUNDARY
- APPROXIMATE PROPOSED EXPANSION WASTE BOUNDARY
- EXISTING CONTOUR
- EXISTING ROAD
- EXISTING VEGETATION
- EXISTING FENCE
- EXISTING CULVERT
- PROPOSED GROUND SURFACE ELEVATION CONTOUR (FEET-MSL)
- PROPOSED ROAD
- PROPOSED CULVERT
- EXISTING FORCEMAIN
- EXISTING LEACHATE COLLECTION PIPE
- EXISTING LEACHATE CLEANOUT LOCATION
- EXISTING LEACHATE VAULT LOCATION
- EXISTING LEACHATE COLLECTION SUMP LOCATION
- PROPOSED FORCEMAIN
- PROPOSED LEACHATE COLLECTION PIPE
- PROPOSED LEACHATE CLEANOUT LOCATION
- PROPOSED LEACHATE VAULT/MANHOLE LOCATION
- PROPOSED LEACHATE COLLECTION SUMP LOCATION
- PROPOSED DRAIN TILE
- STORMWATER MANHOLE
- STORMWATER HEADWALL

NOTES

1. EXISTING CONTOURS DEVELOPED FROM SITE AERIAL TOPOGRAPHIC SURVEY BY COM, INC. ON 10/22/2018 EXCEPT STORMWATER MANAGEMENT FEATURES ASSOCIATED WITH SITE 2 EAST (DITCHES AND BASIN 5R). STORMWATER DESIGN GRADES ARE SHOWN FOR THESE FEATURES FOR COMPLETENESS, AS NOT ALL GRADES ARE CAPTURED BY THE TOPOGRAPHIC SURVEY.
2. CURRENT TOPOGRAPHY MAY DIFFER FROM THAT SHOWN.
3. FOR CLARITY, NOT ALL SITE FEATURES MAY BE SHOWN.
4. CELL DEVELOPMENT WILL PROCEED IN NUMERICAL ORDER. VERTICAL EXPANSION WILL PROGRESS CONCURRENT WITH CELL 11 DEVELOPMENT.
5. THE TEMPORARY STORMWATER COLLECTION SUMP AND ASSOCIATED DITCH SHOWN ALONG THE NORTHERN EDGE OF THE NEWLY CONSTRUCTED CELL REPRESENTS A TYPICAL INTERIM STORMWATER MANAGEMENT SYSTEM DURING CELL CONSTRUCTION. ACTUAL INTERIM STORMWATER MANAGEMENT STRUCTURES MAY DIFFER FROM WHAT IS SHOWN BASED ON OPERATIONAL NEEDS.
6. THE TEMPORARY TERRACE BENCH AND DRAINAGE DITCH SHOWN ALONG THE OPERATIONAL SLOPE OF THE LANDFILL REPRESENTS A TYPICAL INTERIM STORMWATER MANAGEMENT FEATURE. TEMPORARY TERRACE BENCHES MAY BE USED TO COLLECT STORMWATER FROM AREAS OF THE OPERATIONAL SLOPE WHERE INTERMEDIATE COVER HAS BEEN APPLIED. INTERIM STORMWATER MANAGEMENT STRUCTURES MAY DIFFER FROM WHAT IS SHOWN BASED ON OPERATIONAL NEEDS.
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8. THE ANTICIPATED CONSTRUCTION PHASING DEPICTED IN THIS DRAWING IS SUBJECT TO CHANGE BASED ON OPERATIONAL NEEDS.

SECTION OR DETAIL LABEL

DRAWING ON WHICH SECTION OR DETAIL IS SHOWN

SECTIONS AND DETAIL KEY

REV. NO.	DATE	DESCRIPTION

GFL GREEN FOR LIFE environmental

APTIM Environmental & Infrastructure, LLC

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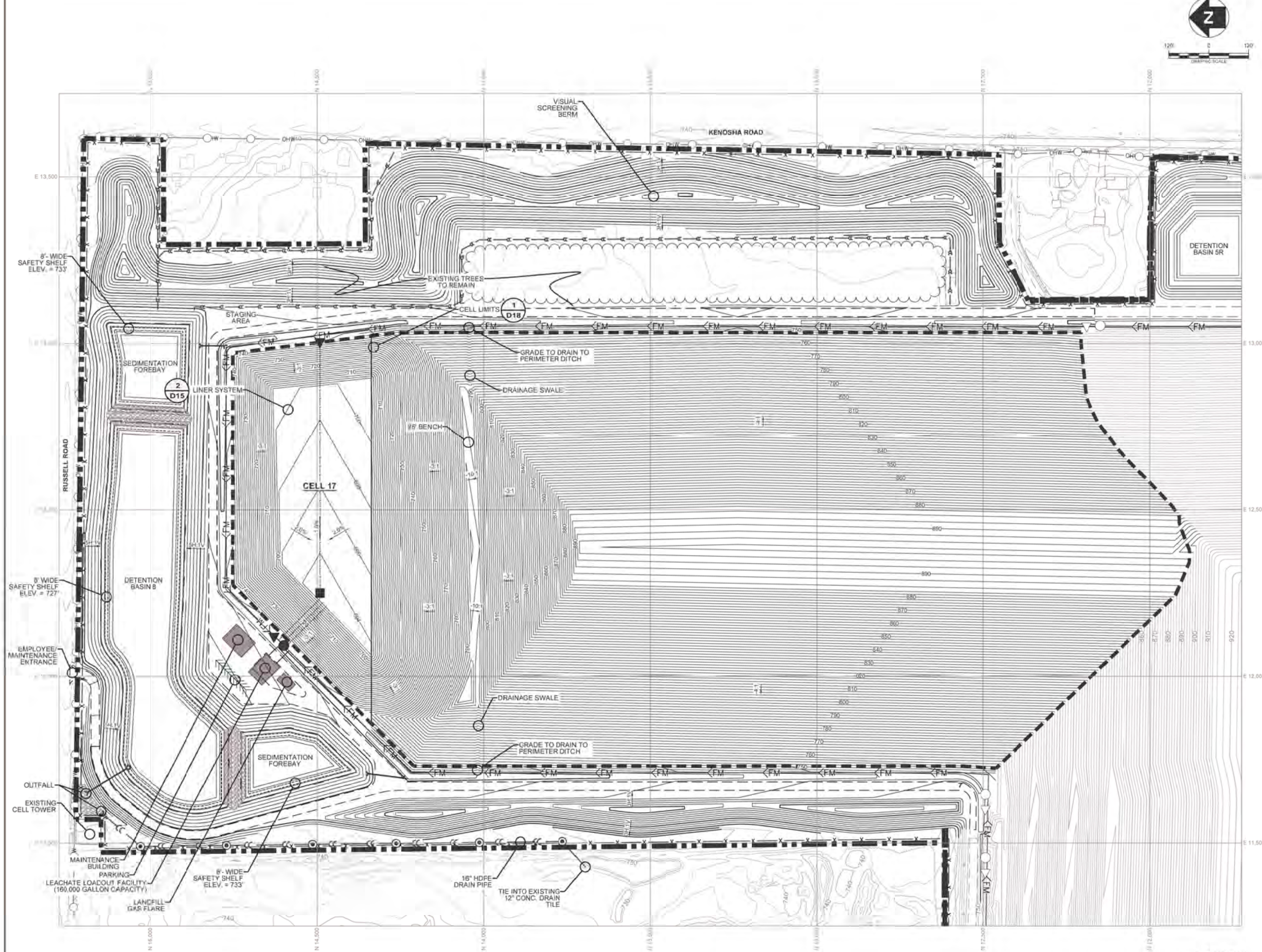
ZION LANDFILL - SITE 2 NORTH EXPANSION
CITY OF ZION, ILLINOIS

LANDFILL PHASING PLAN
PHASE F

PROJ. NO.:	631020105	DATE:	DECEMBER 2022
DESIGNED BY:	DAM/BWM/KM	DRAWING NO.:	D35
DRAWN BY:	BWM/NV/KM		
CHECKED BY:	DAM		
APPROVED BY:	DAM		35 OF 37 SHEETS



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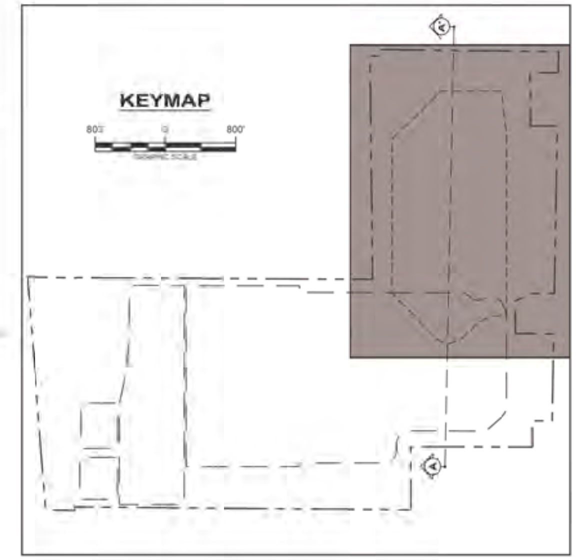

LEGEND

- APPROXIMATE FACILITY BOUNDARY
- APPROXIMATE EXISTING WASTE BOUNDARY
- APPROXIMATE PROPOSED EXPANSION WASTE BOUNDARY
- EXISTING CONTOUR
- EXISTING ROAD
- EXISTING VEGETATION
- EXISTING FENCE
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- PROPOSED LEACHATE COLLECTION SUMP LOCATION
- PROPOSED DRAIN TILE
- STORMWATER MANHOLE
- STORMWATER HEADWALL

NOTES

1. EXISTING CONTOURS DEVELOPED FROM SITE AERIAL TOPOGRAPHIC SURVEY BY CQM, INC. ON 10/22/2018 EXCEPT STORMWATER MANAGEMENT FEATURES ASSOCIATED WITH SITE 2 EAST (DITCHES AND BASIN 5R). STORMWATER DESIGN GRADES ARE SHOWN FOR THESE FEATURES FOR COMPLETENESS, AS NOT ALL GRADES ARE CAPTURED BY THE TOPOGRAPHIC SURVEY.
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SECTIONS AND DETAIL KEY

REV. NO.	DATE	DESCRIPTION

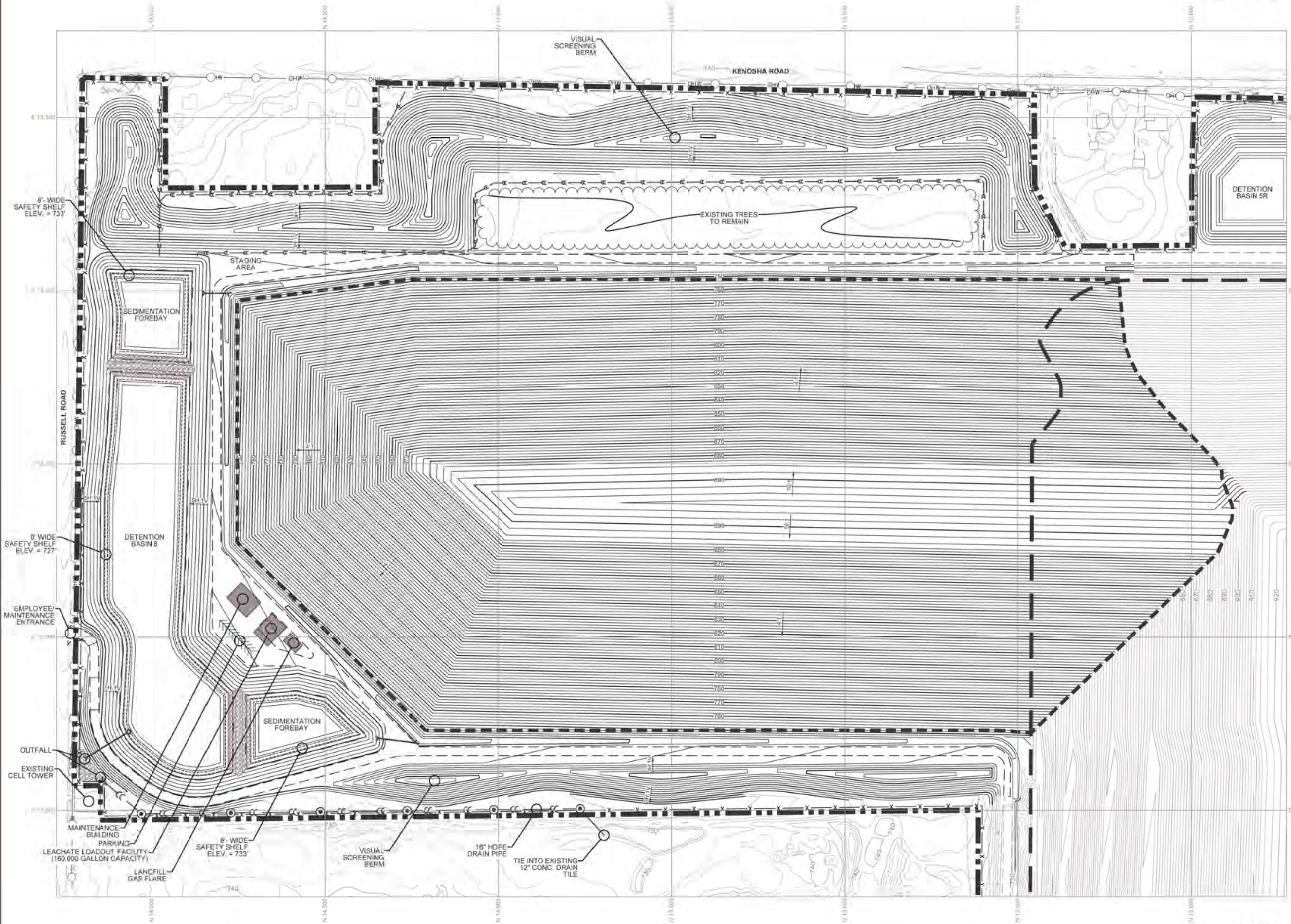
GFL GREEN FOR LIFE environmental

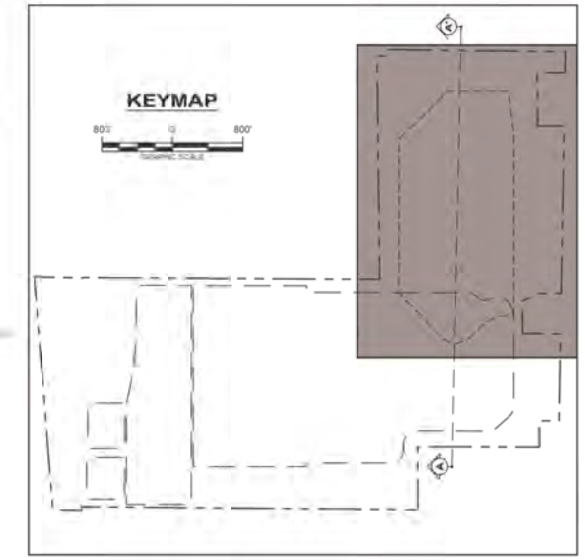
APTIM Environmental & Infrastructure, LLC

ZION LANDFILL - SITE 2 NORTH EXPANSION
CITY OF ZION, ILLINOIS

LANDFILL PHASING PLAN
PHASE G

PROJ. NO.	631020105	DATE:	DECEMBER 2022
DESIGNED BY:	DAM/BWM/RM	DRAWING NO.	D36
DRAWN BY:	BWM/NV/RM		
CHECKED BY:	DAM		
APPROVED BY:	DAM		36 OF 37 SHEETS





LEGEND

- APPROXIMATE FACILITY BOUNDARY
- APPROXIMATE EXISTING WASTE BOUNDARY
- APPROXIMATE PROPOSED EXPANSION WASTE BOUNDARY
- EXISTING CONTOUR
- EXISTING ROAD
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- EXISTING FENCE
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- STORMWATER HEADWALL

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SECTIONS AND DETAIL KEY

REV. NO.	DATE	DESCRIPTION

GFL GREEN FOR LIFE environmental

APTIM Environmental & Infrastructure, LLC

ZION LANDFILL - SITE 2 NORTH EXPANSION
CITY OF ZION, ILLINOIS

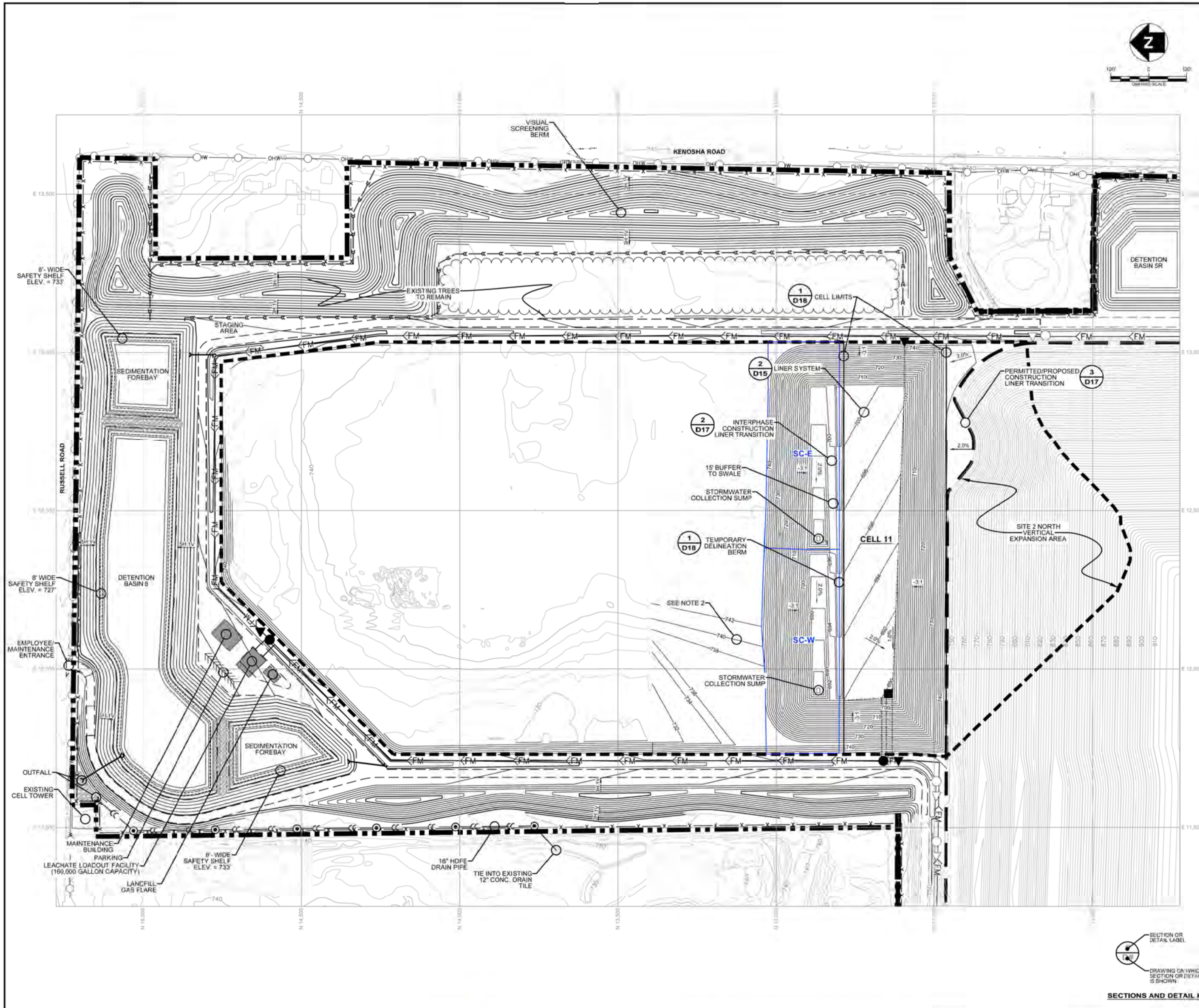
LANDFILL PHASING PLAN PHASE H

PROJ. NO:	631020185	DATE:	DECEMBER 2022
DESIGNED BY:	DAM/BWM/RM	DRAWING NO:	D37
DRAWN BY:	BWM/NV/RM		
CHECKED BY:	DAM		
APPROVED BY:	DAM		37 OF 37 SHEETS

Phase A

25-year, 24-hour HydroCAD Outputs

APTIM



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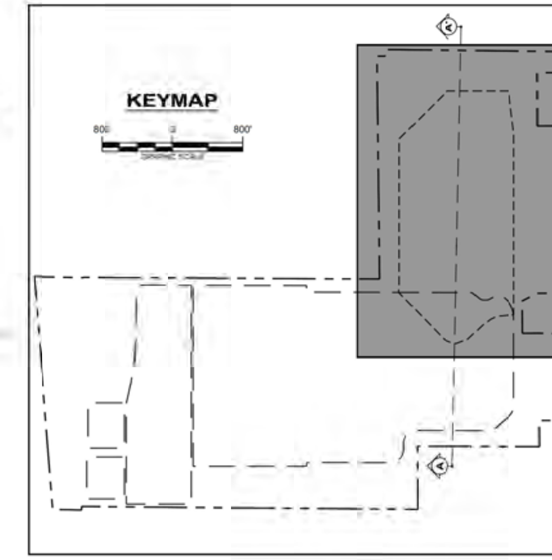

LEGEND

- APPROXIMATE FACILITY BOUNDARY
- APPROXIMATE EXISTING WASTE BOUNDARY
- APPROXIMATE PROPOSED EXPANSION WASTE BOUNDARY
- EXISTING CONTOUR
- EXISTING ROAD
- EXISTING VEGETATION
- EXISTING FENCE
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- PROPOSED LEACHATE VAULT/MANHOLE LOCATION
- PROPOSED LEACHATE COLLECTION SUMP LOCATION
- PROPOSED DRAIN TILE
- STORMWATER MANHOLE
- STORMWATER HEADWALL
- SUBCATCHMENT BOUNDARY

NOTES

1. EXISTING CONTOURS DEVELOPED FROM SITE AERIAL TOPOGRAPHIC SURVEY BY CQM, INC. ON 10/22/2018 EXCEPT STORMWATER MANAGEMENT FEATJRES ASSOCIATED WITH SITE 2 EAST (DITCHES AND BASIN 5R). STORMWATER DESIGN GRADES ARE SHOWN FOR THESE FEATURES FOR COMPLETENESS, AS NOT ALL GRADES ARE CAPTURED BY THE TOPOGRAPHIC SURVEY.
2. THE EXISTING STOCKPILE AND ASSOCIATED BASIN WITHIN THE HORIZONTAL EXPANSION AREA WILL BE REMOVED BEFORE CELL CONSTRUCTION COMMENCES. SURVEYED EXISTING GRADES ARE MODIFIED IN THIS PHASING PLAN TO APPROXIMATE ANTICIPATED SITE TOPOGRAPHY FOLLOWING REMOVAL OF THE STOCKPILE.
3. CURRENT TOPOGRAPHY MAY DIFFER FROM THAT SHOWN.
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REV. NO.	DATE	DESCRIPTION

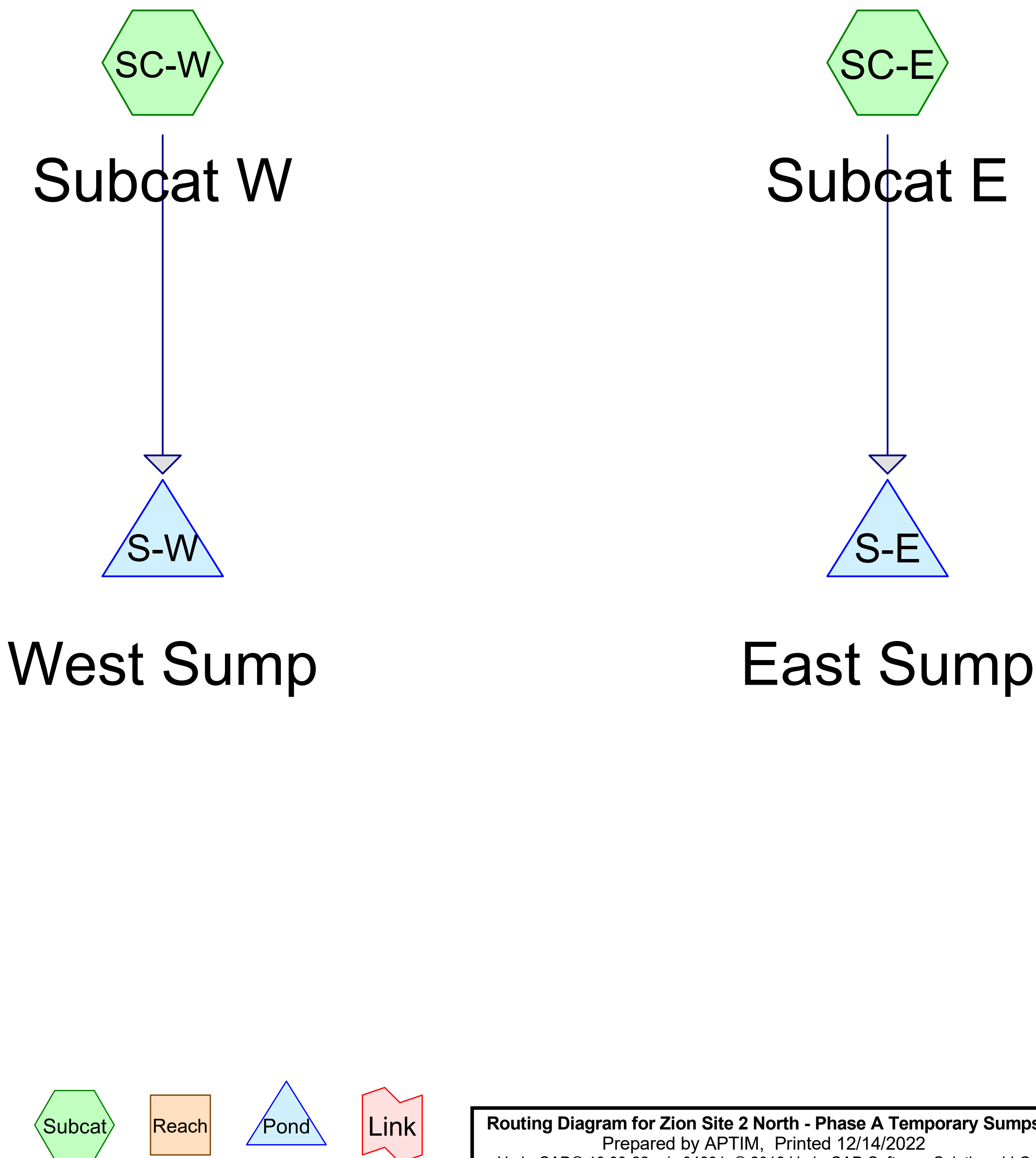
GFL GREEN FOR LIFE environmental

APTIM Environmental & Infrastructure, LLC

ZION LANDFILL - SITE 2 NORTH EXPANSION
CITY OF ZION, ILLINOIS

LANDFILL PHASING PLAN - PHASE A
TEMPORARY STORMWATER CONVEYANCE STRUCTURES
SUBCATCHMENT DELINEATION

PROJ. NO.:	631020105	DATE:	DECEMBER 2022
DESIGNED BY:	DAM/BWM/KM	DRAWING NO.	
DRAWN BY:	BWM/NV/KM		1
CHECKED BY:	DAM		
APPROVED BY:	DAM		1 OF 7 SHEETS



Routing Diagram for Zion Site 2 North - Phase A Temporary Sumps
Prepared by APTIM, Printed 12/14/2022

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
6.96	94	Newly graded area, HSG D (SC-E, SC-W)
6.96	**94**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.00	HSG A	
0.00	HSG B	
0.00	HSG C	
6.96	HSG D	SC-E, SC-W
0.00	Other	
6.96		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.00	0.00	0.00	6.96	0.00	6.96	Newly graded area	SC-E, SC-W
0.00	**0.00**	**0.00**	**6.96**	**0.00**	**6.96**	**TOTAL AREA**	

Time span=0.00-120.00 hrs, dt=0.05 hrs, 2401 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment SC-E: Subcat E Runoff Area=149,996 sf 0.00% Impervious Runoff Depth=5.74"
Tc=0.0 min CN=94 Runoff=2.03 cfs 1.648 af

Subcatchment SC-W: Subcat W Runoff Area=153,275 sf 0.00% Impervious Runoff Depth=5.74"
Tc=0.0 min CN=94 Runoff=2.07 cfs 1.684 af

Pond S-E: East Sump Peak Elev=697.93' Storage=71,779 cf Inflow=2.03 cfs 1.648 af
Outflow=0.00 cfs 0.000 af

Pond S-W: West Sump Peak Elev=692.00' Storage=73,349 cf Inflow=2.07 cfs 1.684 af
Outflow=0.00 cfs 0.000 af

Total Runoff Area = 6.96 ac Runoff Volume = 3.332 af Average Runoff Depth = 5.74"
100.00% Pervious = 6.96 ac 0.00% Impervious = 0.00 ac

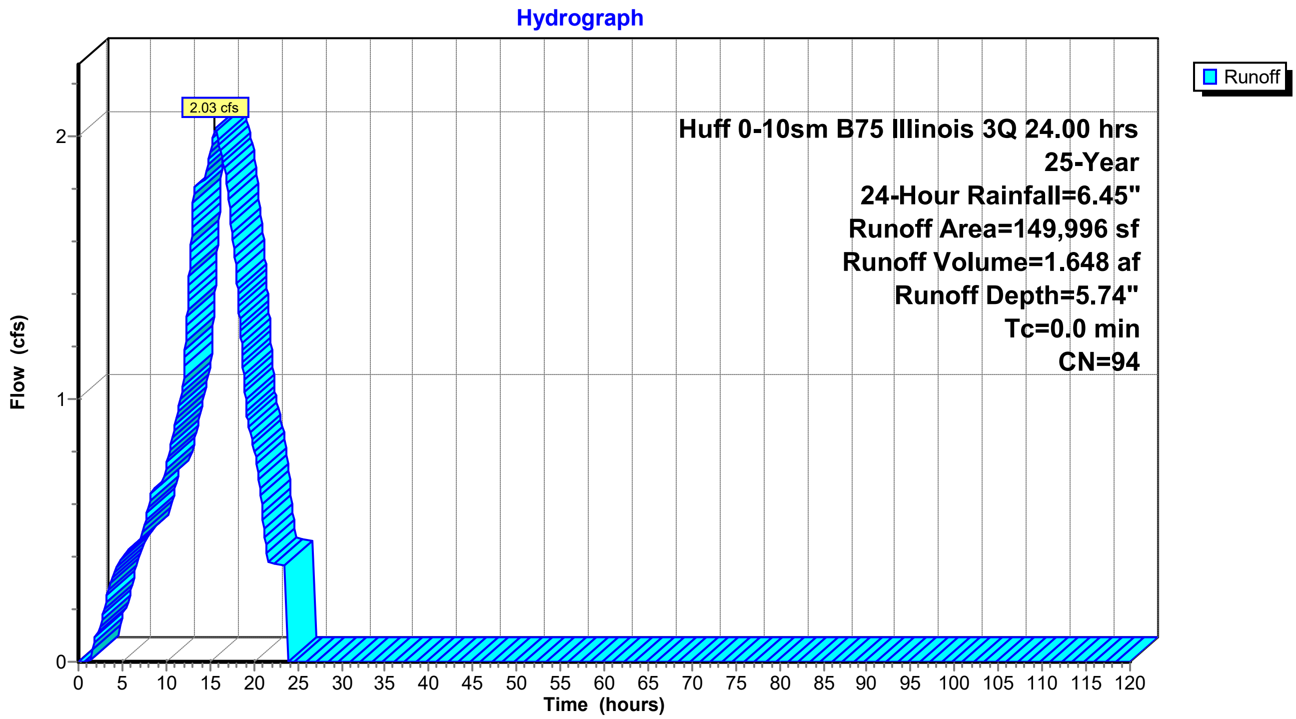
Summary for Subcatchment SC-E: Subcat E

Runoff = 2.03 cfs @ 15.60 hrs, Volume= 1.648 af, Depth= 5.74"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Huff 0-10sm B75 Illinois 3Q 24.00 hrs 25-Year, 24-Hour Rainfall=6.45"

Area (sf)	CN	Description
149,996	94	Newly graded area, HSG D
149,996		100.00% Pervious Area

Subcatchment SC-E: Subcat E



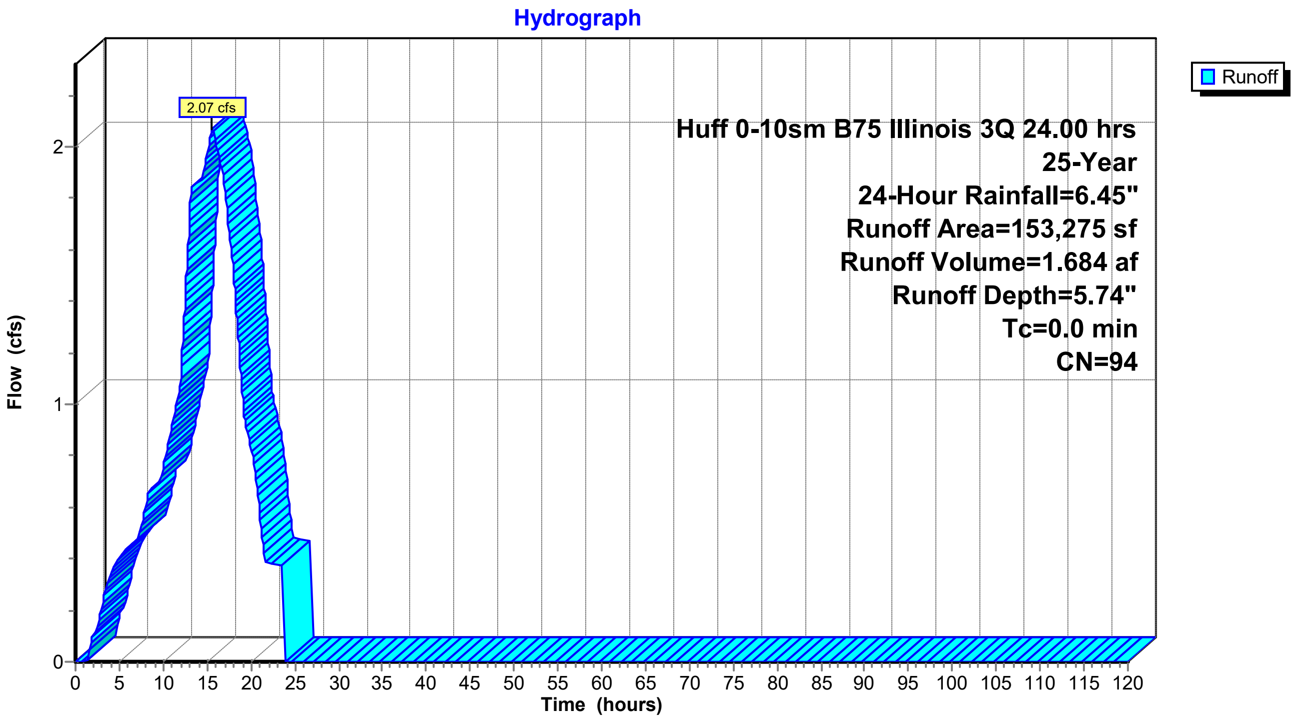
Summary for Subcatchment SC-W: Subcat W

Runoff = 2.07 cfs @ 15.60 hrs, Volume= 1.684 af, Depth= 5.74"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Huff 0-10sm B75 Illinois 3Q 24.00 hrs 25-Year, 24-Hour Rainfall=6.45"

Area (sf)	CN	Description
153,275	94	Newly graded area, HSG D
153,275		100.00% Pervious Area

Subcatchment SC-W: Subcat W



Summary for Pond S-E: East Sump

Inflow Area = 3.44 ac, 0.00% Impervious, Inflow Depth = 5.74" for 25-Year, 24-Hour event
Inflow = 2.03 cfs @ 15.60 hrs, Volume= 1.648 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min

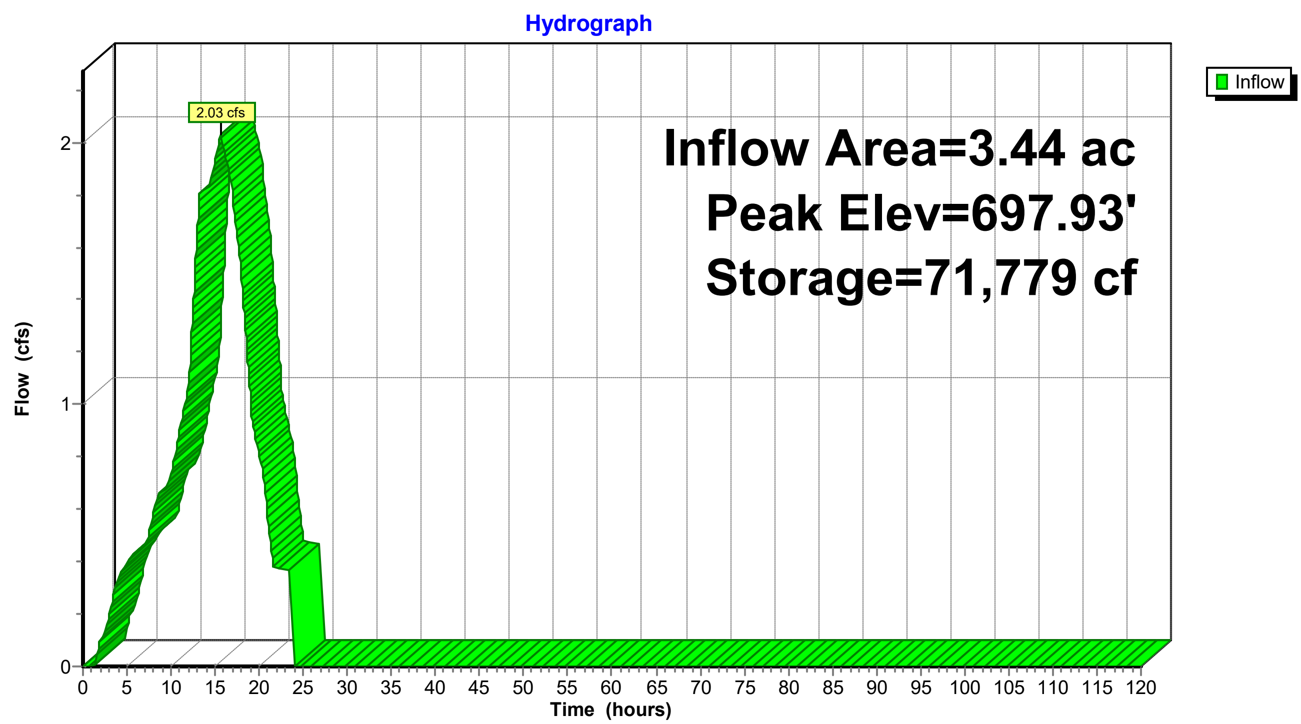
Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Peak Elev= 697.93' @ 24.05 hrs Surf.Area= 23,456 sf Storage= 71,779 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	690.00'	73,404 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
690.00	156	0	0
692.00	2,433	2,589	2,589
694.00	7,598	10,031	12,620
696.00	14,709	22,307	34,927
698.00	23,768	38,477	73,404

Pond S-E: East Sump



Summary for Pond S-W: West Sump

Inflow Area = 3.52 ac, 0.00% Impervious, Inflow Depth = 5.74" for 25-Year, 24-Hour event
Inflow = 2.07 cfs @ 15.60 hrs, Volume= 1.684 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min

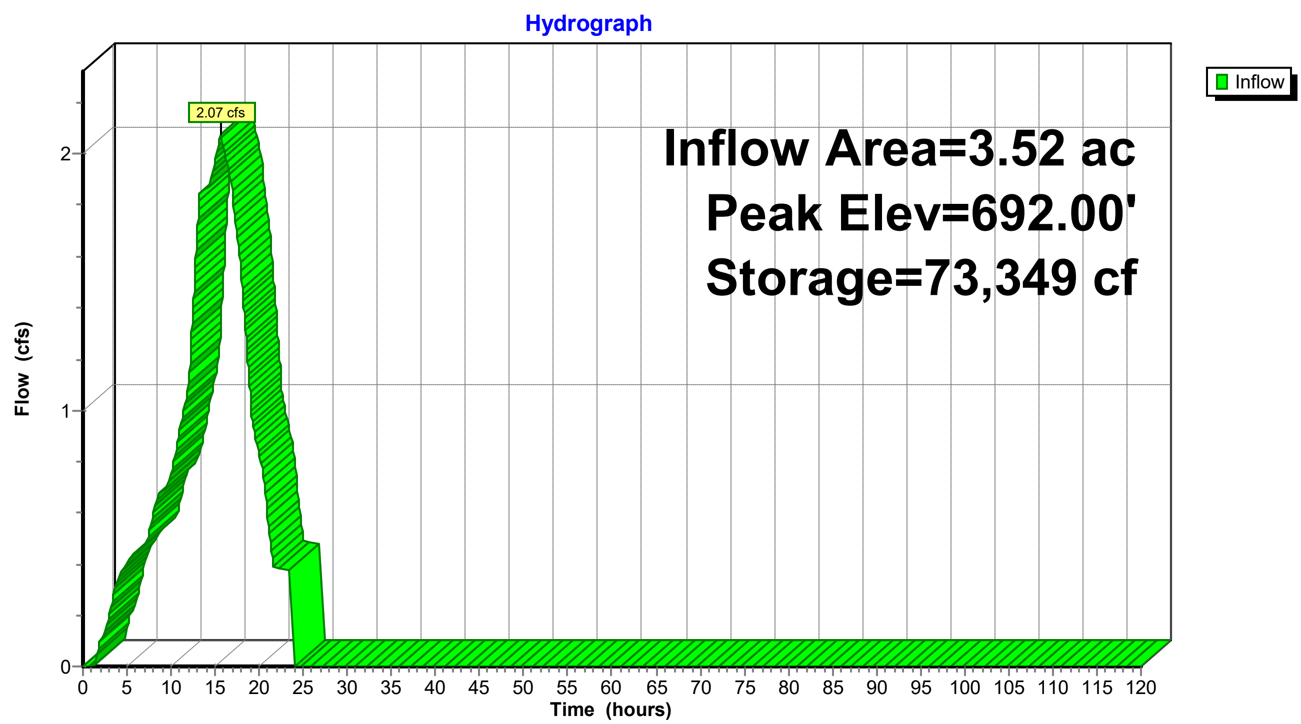
Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Peak Elev= 692.00' @ 24.05 hrs Surf.Area= 23,759 sf Storage= 73,349 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no outflow)

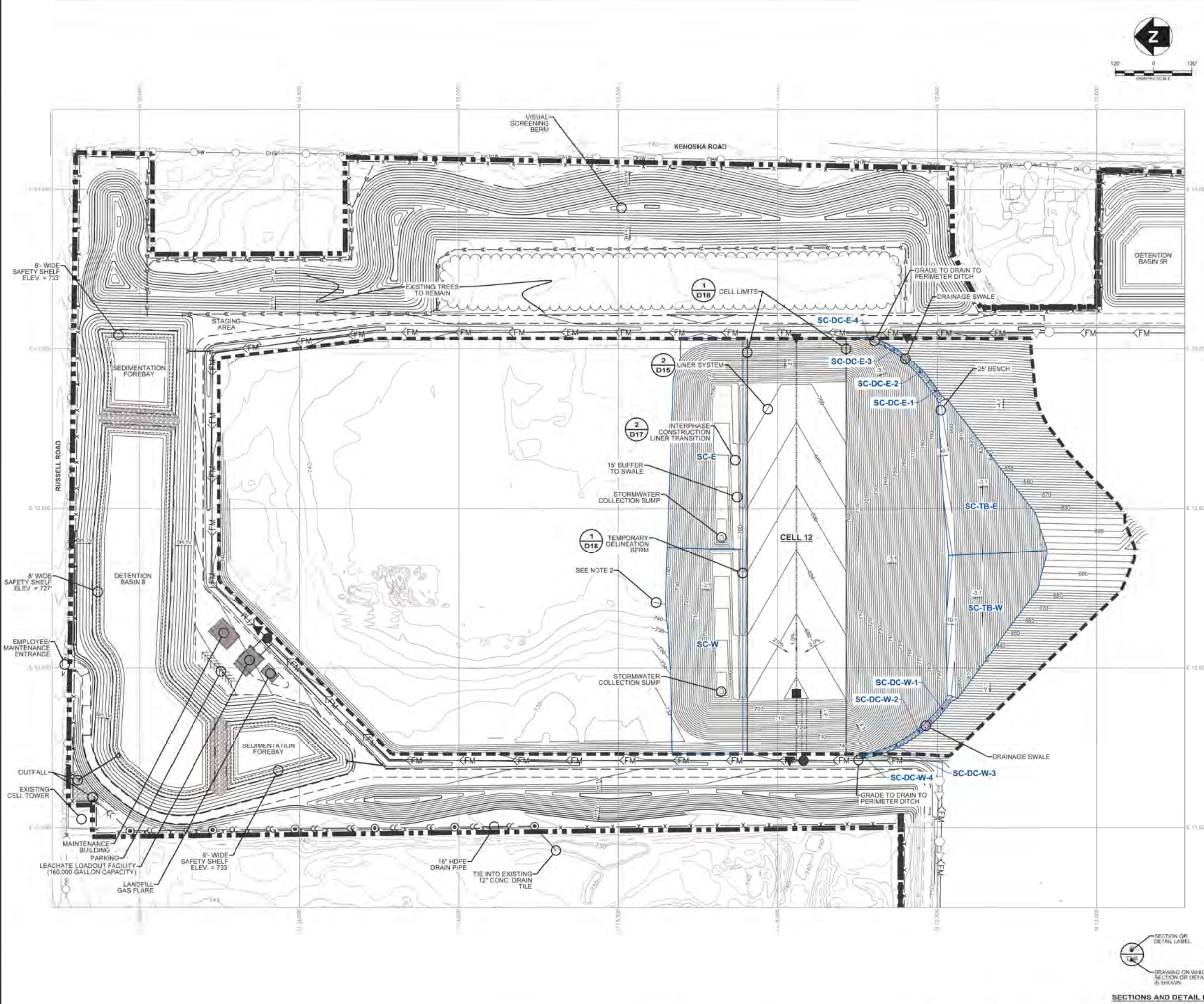
Volume	Invert	Avail.Storage	Storage Description
#1	684.00'	73,406 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

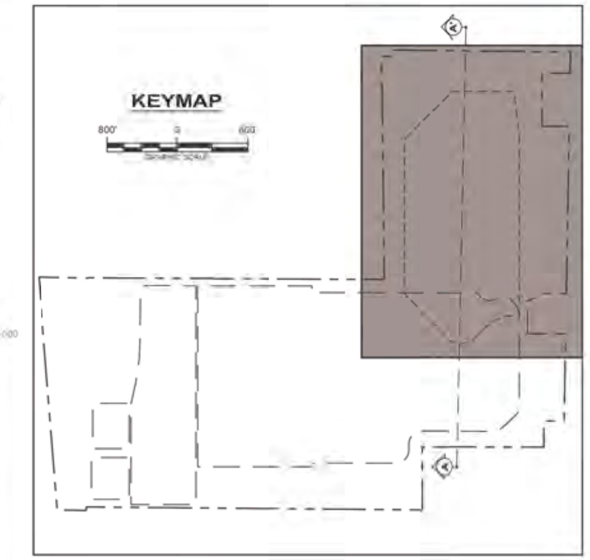
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
684.00	156	0	0
686.00	2,433	2,589	2,589
688.00	7,598	10,031	12,620
690.00	14,709	22,307	34,927
692.00	23,770	38,479	73,406

Pond S-W: West Sump



Phase B
25-year, 24-hour HydroCAD Outputs





LEGEND

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- APPROXIMATE PROPOSED EXPANSION WASTE BOUNDARY
- EXISTING CONTOUR
- EXISTING ROAD
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- EXISTING LEACHATE CLEANOUT LOCATION
- EXISTING LEACHATE VAULT LOCATION
- EXISTING LEACHATE COLLECTION SUMP LOCATION
- PROPOSED FORCEMAIN
- PROPOSED LEACHATE COLLECTION PIPE
- PROPOSED LEACHATE CLEANOUT LOCATION
- PROPOSED LEACHATE VAULT/MANHOLE LOCATION
- PROPOSED LEACHATE COLLECTION SUMP LOCATION
- PROPOSED DRAIN TILE
- STORMWATER MANHOLE
- STORMWATER HEADWALL
- SUBCATCHMENT BOUNDARY

NOTES

1. EXISTING CONTOURS DEVELOPED FROM SITE AERIAL TOPOGRAPHIC SURVEY BY CQM, INC. ON 10/22/2018 EXCEPT STORMWATER MANAGEMENT FEATURES ASSOCIATED WITH SITE 2 EAST (DITCHES AND BASIN 5R). STORMWATER DESIGN GRADES ARE SHOWN FOR THESE FEATURES FOR COMPLETENESS, AS NOT ALL GRADES ARE CAPTURED BY THE TOPOGRAPHIC SURVEY.
2. THE EXISTING STOCKPILE AND ASSOCIATED BASIN WITHIN THE HORIZONTAL EXPANSION AREA WILL BE REMOVED BEFORE CELL CONSTRUCTION COMMENCES. SURVEYED EXISTING GRADES ARE MODIFIED IN THIS PHASING PLAN TO APPROXIMATE ANTICIPATED SITE TOPOGRAPHY FOLLOWING REMOVAL OF THE STOCKPILE.
3. CURRENT TOPOGRAPHY MAY DIFFER FROM THAT SHOWN.
4. FOR CLARITY, NOT ALL SITE FEATURES MAY BE SHOWN.
5. CELL DEVELOPMENT WILL PROCEED IN NUMERICAL ORDER. VERTICAL EXPANSION WILL PROGRESS CONCURRENT WITH CELL 11 DEVELOPMENT.
6. THE TEMPORARY STORMWATER COLLECTION SUMP AND ASSOCIATED DITCH SHOWN ALONG THE NORTHERN EDGE OF THE NEWLY CONSTRUCTED CELL REPRESENTS A TYPICAL INTERIM STORMWATER MANAGEMENT SYSTEM DURING CELL CONSTRUCTION. ACTUAL INTERIM STORMWATER MANAGEMENT STRUCTURES MAY DIFFER FROM WHAT IS SHOWN BASED ON OPERATIONAL NEEDS.
7. THE TEMPORARY TERRACE BENCH AND DRAINAGE DITCH SHOWN ALONG THE OPERATIONAL SLOPE OF THE LANDFILL REPRESENTS A TYPICAL INTERIM STORMWATER MANAGEMENT FEATURE. TEMPORARY TERRACE BENCHES MAY BE USED TO COLLECT STORMWATER FROM AREAS OF THE OPERATIONAL SLOPE WHERE INTERMEDIATE COVER HAS BEEN APPLIED. INTERIM STORMWATER MANAGEMENT STRUCTURES MAY DIFFER FROM WHAT IS SHOWN BASED ON OPERATIONAL NEEDS.
8. INTERIM STORMWATER MANAGEMENT STRUCTURES MAY BE MODIFIED TO ACCOMMODATE CONSTRUCTION ACTIVITIES AS THEY PROGRESS, AND SHOULD BE APPROPRIATELY SIZED TO MANAGE STORMWATER RUNOFF DURING CONSTRUCTION.
9. THE ANTICIPATED CONSTRUCTION PHASING DEPICTED IN THIS DRAWING IS SUBJECT TO CHANGE BASED ON OPERATIONAL NEEDS.

REV. NO.	DATE	DESCRIPTION

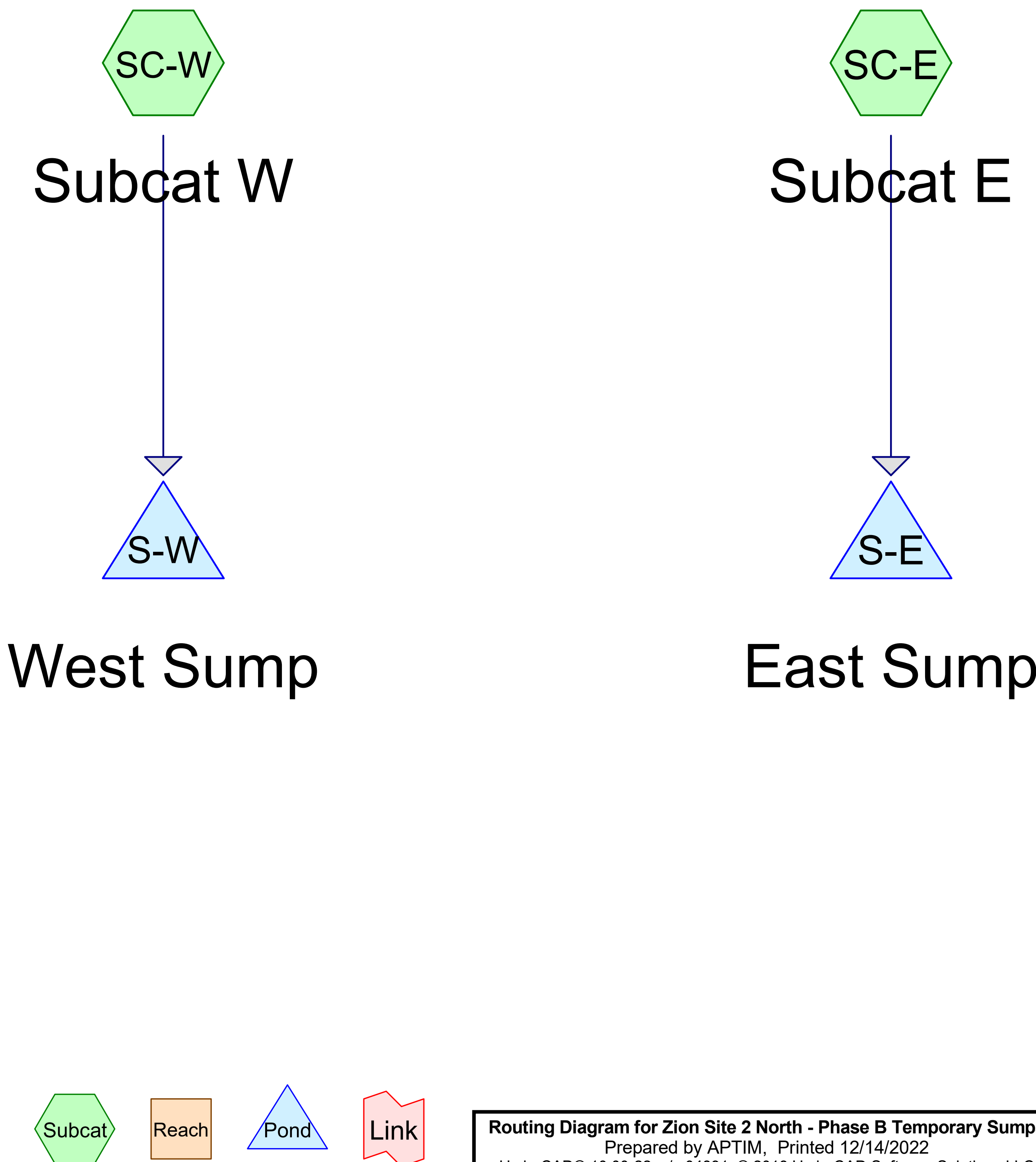
GFL GREEN FOR LIFE environmental

APTIM Environmental & Infrastructure, LLC

ZION LANDFILL - SITE 2 NORTH EXPANSION
CITY OF ZION, ILLINOIS

LANDFILL PHASING PLAN - PHASE B
TEMPORARY STORMWATER CONVEYANCE STRUCTURES
SUBCATCHMENT DELINEATION

PROJ. NO.: 631020105	DATE: DECEMBER 2022
DESIGNED BY: DAM/BWM/KM	DRAWING NO.
DRAWN BY: BWM/NV/KM	2
CHECKED BY: DAM	
APPROVED BY: DAM	2 OF 7 SHEETS



Routing Diagram for Zion Site 2 North - Phase B Temporary Sumps
Prepared by APTIM, Printed 12/14/2022
HydroCAD® 10.00-22 s/n 04891 © 2018 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
6.77	94	Newly graded area, HSG D (SC-E, SC-W)
6.77	**94**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.00	HSG A	
0.00	HSG B	
0.00	HSG C	
6.77	HSG D	SC-E, SC-W
0.00	Other	
6.77		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.00	0.00	0.00	6.77	0.00	6.77	Newly graded area	SC-E, SC-W
0.00	**0.00**	**0.00**	**6.77**	**0.00**	**6.77**	**TOTAL AREA**	

Time span=0.00-120.00 hrs, dt=0.05 hrs, 2401 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment SC-E: Subcat E Runoff Area=146,373 sf 0.00% Impervious Runoff Depth=5.74"
Tc=0.0 min CN=94 Runoff=1.98 cfs 1.608 af

Subcatchment SC-W: Subcat W Runoff Area=148,742 sf 0.00% Impervious Runoff Depth=5.74"
Tc=0.0 min CN=94 Runoff=2.01 cfs 1.634 af

Pond S-E: East Sump Peak Elev=697.86' Storage=70,044 cf Inflow=1.98 cfs 1.608 af
Outflow=0.00 cfs 0.000 af

Pond S-W: West Sump Peak Elev=691.90' Storage=71,177 cf Inflow=2.01 cfs 1.634 af
Outflow=0.00 cfs 0.000 af

Total Runoff Area = 6.77 ac Runoff Volume = 3.242 af Average Runoff Depth = 5.74"
100.00% Pervious = 6.77 ac 0.00% Impervious = 0.00 ac

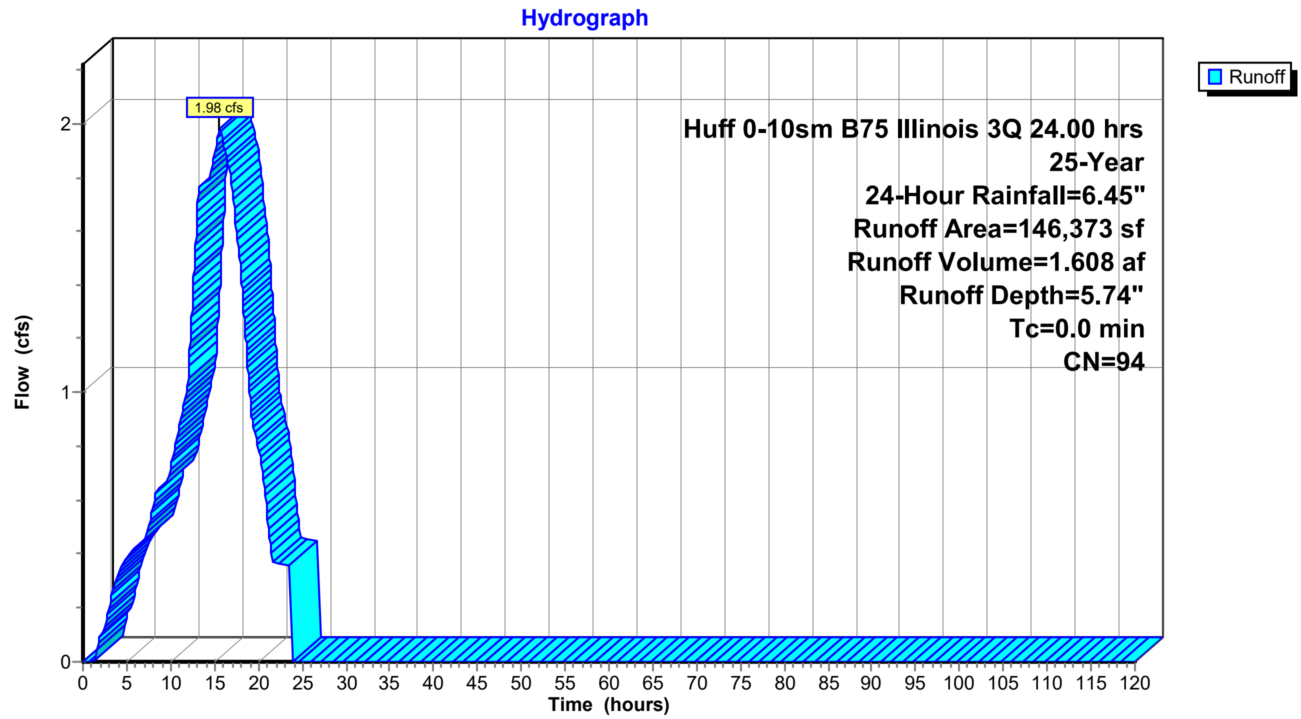
Summary for Subcatchment SC-E: Subcat E

Runoff = 1.98 cfs @ 15.60 hrs, Volume= 1.608 af, Depth= 5.74"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Huff 0-10sm B75 Illinois 3Q 24.00 hrs 25-Year, 24-Hour Rainfall=6.45"

Area (sf)	CN	Description
146,373	94	Newly graded area, HSG D
146,373		100.00% Pervious Area

Subcatchment SC-E: Subcat E



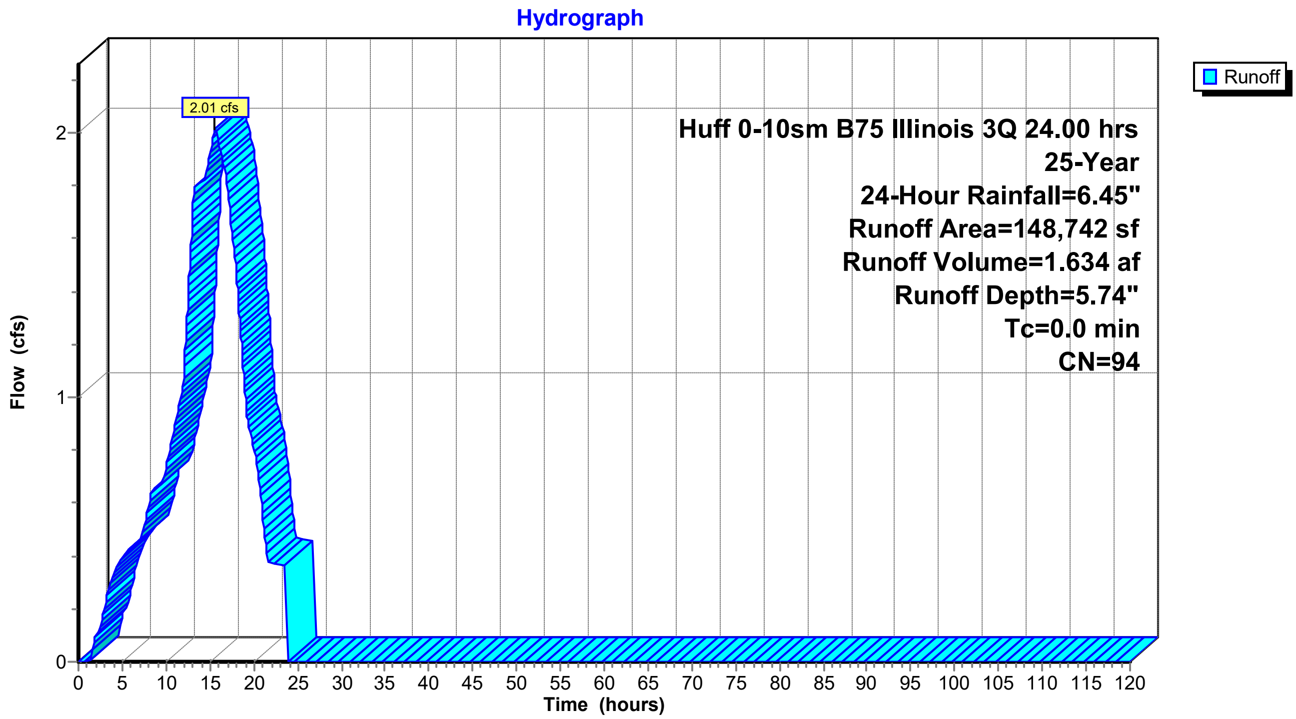
Summary for Subcatchment SC-W: Subcat W

Runoff = 2.01 cfs @ 15.60 hrs, Volume= 1.634 af, Depth= 5.74"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Huff 0-10sm B75 Illinois 3Q 24.00 hrs 25-Year, 24-Hour Rainfall=6.45"

Area (sf)	CN	Description
148,742	94	Newly graded area, HSG D
148,742		100.00% Pervious Area

Subcatchment SC-W: Subcat W



Summary for Pond S-E: East Sump

Inflow Area = 3.36 ac, 0.00% Impervious, Inflow Depth = 5.74" for 25-Year, 24-Hour event
Inflow = 1.98 cfs @ 15.60 hrs, Volume= 1.608 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min

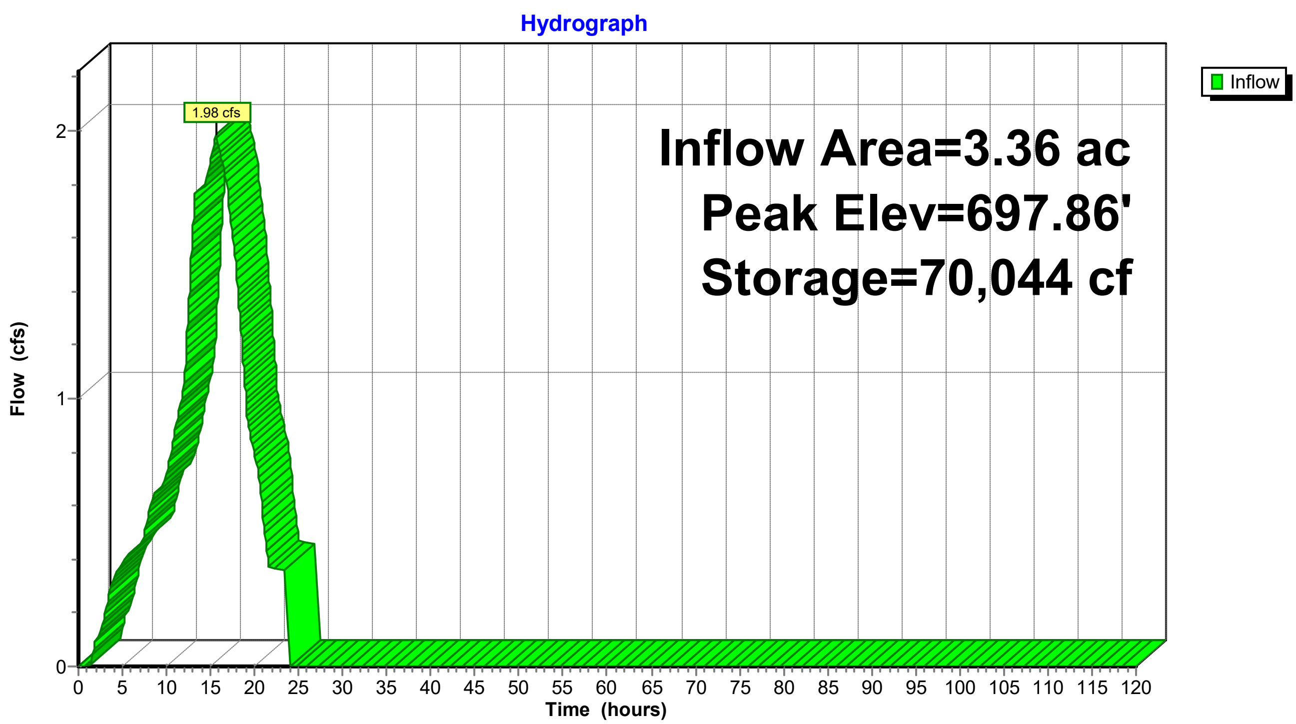
Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Peak Elev= 697.86' @ 24.05 hrs Surf.Area= 23,119 sf Storage= 70,044 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	690.00'	73,404 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
690.00	156	0	0
692.00	2,433	2,589	2,589
694.00	7,598	10,031	12,620
696.00	14,709	22,307	34,927
698.00	23,768	38,477	73,404

Pond S-E: East Sump



Summary for Pond S-W: West Sump

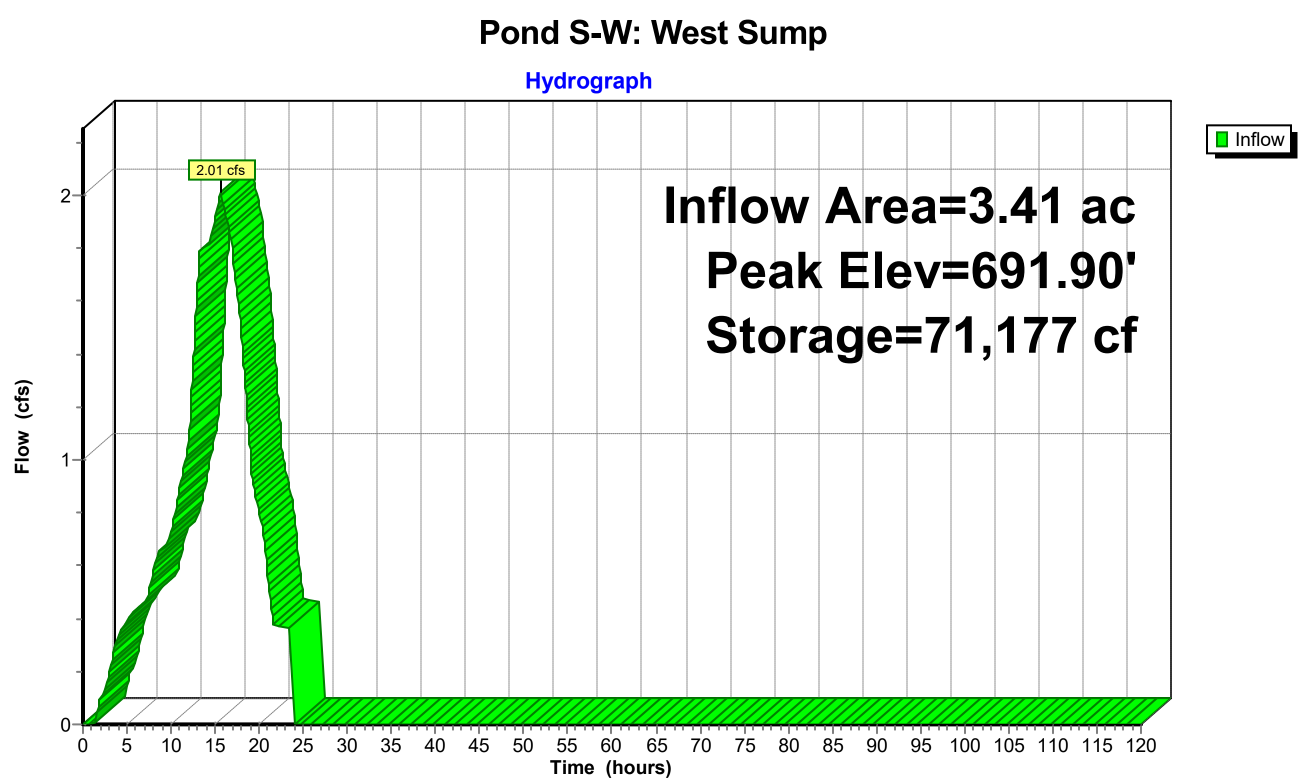
Inflow Area = 3.41 ac, 0.00% Impervious, Inflow Depth = 5.74" for 25-Year, 24-Hour event
Inflow = 2.01 cfs @ 15.60 hrs, Volume= 1.634 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min

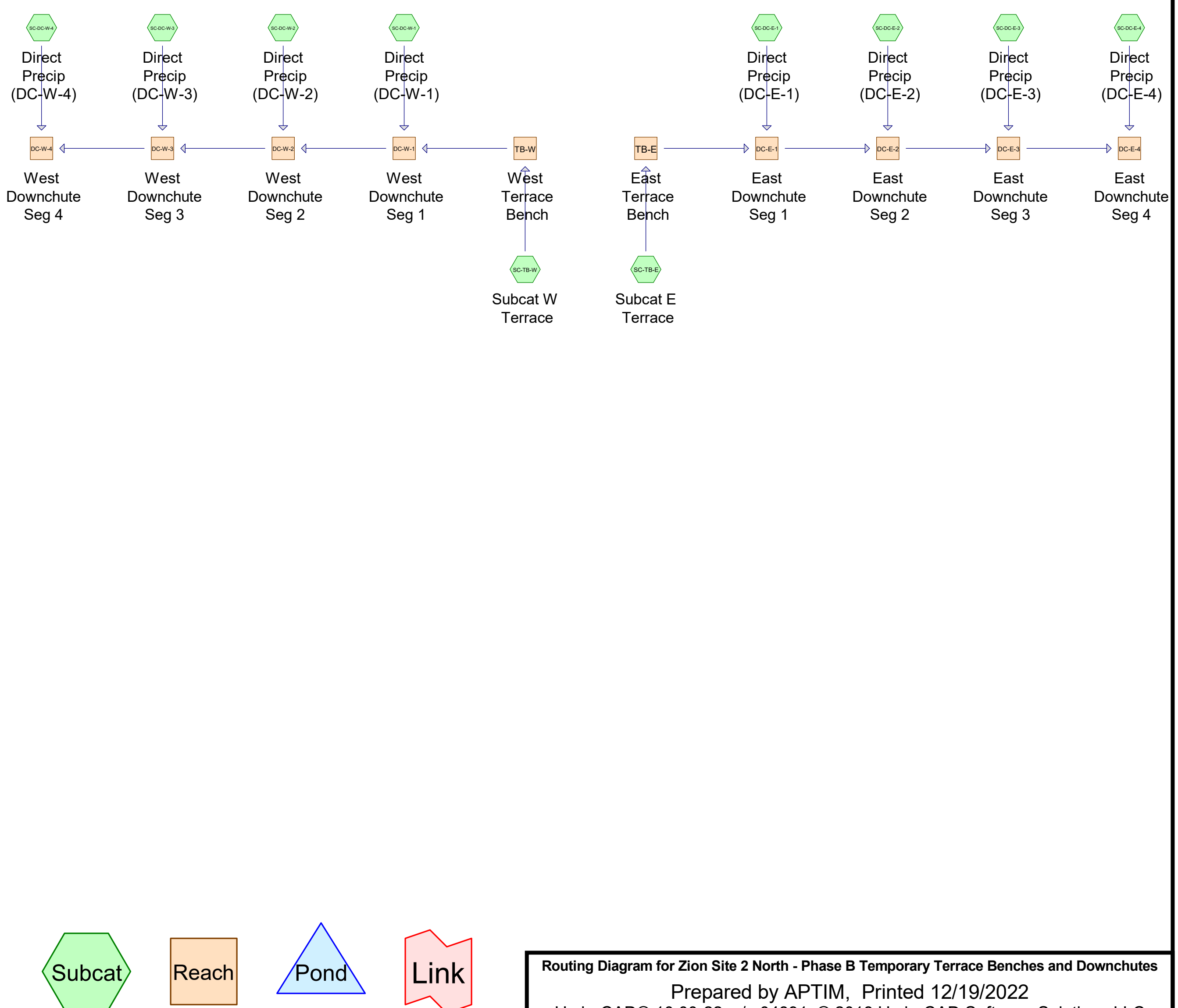
Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Peak Elev= 691.90' @ 24.05 hrs Surf.Area= 23,480 sf Storage= 71,177 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	684.00'	73,585 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
684.00	156	0	0
686.00	2,433	2,589	2,589
688.00	7,598	10,031	12,620
690.00	14,709	22,307	34,927
692.00	23,949	38,658	73,585





Routing Diagram for Zion Site 2 North - Phase B Temporary Terrace Benches and Downchutes

Prepared by APTIM, Printed 12/19/2022

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Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
4.42	94	Newly graded area, HSG D (SC-DC-E-1, SC-DC-E-2, SC-DC-E-3, SC-DC-E-4, SC-DC-W-1, SC-DC-W-2, SC-DC-W-3, SC-DC-W-4, SC-TB-E, SC-TB-W)
4.42	**94**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.00	HSG A	
0.00	HSG B	
0.00	HSG C	
4.42	HSG D	SC-DC-E-1, SC-DC-E-2, SC-DC-E-3, SC-DC-E-4, SC-DC-W-1, SC-DC-W-2, SC-DC-W-3, SC-DC-W-4, SC-TB-E, SC-TB-W
0.00	Other	
4.42		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.00	0.00	0.00	4.42	0.00	4.42	Newly graded area	SC-DC-E-1, SC-DC-E-2, SC-DC-E-3, SC-DC-E-4, SC-DC-W-1, SC-DC-W-2, SC-DC-W-3, SC-DC-W-4, SC-TB-E, SC-TB-W
0.00	**0.00**	**0.00**	**4.42**	**0.00**	**4.42**	**TOTAL AREA**	

Time span=0.00-120.00 hrs, dt=0.05 hrs, 2401 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment SC-DC-E-1: Direct Precip Runoff Area=1,881 sf 0.00% Impervious Runoff Depth=5.74"
Tc=0.0 min CN=94 Runoff=0.03 cfs 0.021 af

Subcatchment SC-DC-E-2: Direct Precip Runoff Area=1,740 sf 0.00% Impervious Runoff Depth=5.74"
Tc=0.0 min CN=94 Runoff=0.02 cfs 0.019 af

Subcatchment SC-DC-E-3: Direct Precip Runoff Area=1,560 sf 0.00% Impervious Runoff Depth=5.74"
Tc=0.0 min CN=94 Runoff=0.02 cfs 0.017 af

Subcatchment SC-DC-E-4: Direct Precip Runoff Area=526 sf 0.00% Impervious Runoff Depth=5.74"
Tc=0.0 min CN=94 Runoff=0.01 cfs 0.006 af

Subcatchment SC-DC-W-1: Direct Precip Runoff Area=1,523 sf 0.00% Impervious Runoff Depth=5.74"
Tc=0.0 min CN=94 Runoff=0.02 cfs 0.017 af

Subcatchment SC-DC-W-2: Direct Precip Runoff Area=1,645 sf 0.00% Impervious Runoff Depth=5.74"
Tc=0.0 min CN=94 Runoff=0.02 cfs 0.018 af

Subcatchment SC-DC-W-3: Direct Precip Runoff Area=1,601 sf 0.00% Impervious Runoff Depth=5.74"
Tc=0.0 min CN=94 Runoff=0.02 cfs 0.018 af

Subcatchment SC-DC-W-4: Direct Precip Runoff Area=608 sf 0.00% Impervious Runoff Depth=5.74"
Tc=0.0 min CN=94 Runoff=0.01 cfs 0.007 af

Subcatchment SC-TB-E: Subcat E Terrace Runoff Area=94,003 sf 0.00% Impervious Runoff Depth=5.74"
Flow Length=309' Slope=0.3333 '/' Tc=1.8 min CN=94 Runoff=1.27 cfs 1.033 af

Subcatchment SC-TB-W: Subcat W Terrace Runoff Area=87,483 sf 0.00% Impervious Runoff Depth=5.74"
Flow Length=309' Slope=0.3333 '/' Tc=1.8 min CN=94 Runoff=1.18 cfs 0.961 af

Reach DC-E-1: East Downchute Seg 1 Avg. Flow Depth=0.04' Max Vel=3.55 fps Inflow=1.29 cfs 1.053 af
n=0.022 L=100.0' S=0.1770 '/' Capacity=76.37 cfs Outflow=1.29 cfs 1.053 af

Reach DC-E-2: East Downchute Seg 2 Avg. Flow Depth=0.05' Max Vel=3.47 fps Inflow=1.32 cfs 1.072 af
n=0.022 L=100.0' S=0.1611 '/' Capacity=72.86 cfs Outflow=1.32 cfs 1.072 af

Reach DC-E-3: East Downchute Seg 3 Avg. Flow Depth=0.05' Max Vel=3.14 fps Inflow=1.34 cfs 1.090 af
n=0.022 L=100.0' S=0.1134 '/' Capacity=61.13 cfs Outflow=1.34 cfs 1.090 af

Reach DC-E-4: East Downchute Seg 4 Avg. Flow Depth=0.06' Max Vel=2.74 fps Inflow=1.34 cfs 1.095 af
n=0.022 L=59.9' S=0.0720 '/' Capacity=48.69 cfs Outflow=1.34 cfs 1.095 af

Reach DC-W-1: West Downchute Seg 1 Avg. Flow Depth=0.04' Max Vel=3.39 fps Inflow=1.20 cfs 0.978 af
n=0.022 L=100.0' S=0.1682 '/' Capacity=74.44 cfs Outflow=1.20 cfs 0.978 af

Reach DC-W-2: West Downchute Seg 2 Avg. Flow Depth=0.05' Max Vel=3.34 fps Inflow=1.22 cfs 0.996 af
n=0.022 L=100.0' S=0.1563 '/' Capacity=71.76 cfs Outflow=1.22 cfs 0.996 af

Reach DC-W-3: West Downchute Seg 3 Avg. Flow Depth=0.05' Max Vel=2.99 fps Inflow=1.24 cfs 1.013 af
n=0.022 L=100.0' S=0.1063 '/' Capacity=59.18 cfs Outflow=1.24 cfs 1.013 af

Reach DC-W-4: West Downchute Seg 4 Avg. Flow Depth=0.06' Max Vel=2.52 fps Inflow=1.25 cfs 1.020 af
n=0.022 L=94.3' S=0.0604 '/' Capacity=44.63 cfs Outflow=1.25 cfs 1.020 af

Reach TB-E: East Terrace Bench Avg. Flow Depth=0.33' Max Vel=1.82 fps Inflow=1.27 cfs 1.033 af
n=0.022 L=486.0' S=0.0082 '/' Capacity=285.77 cfs Outflow=1.27 cfs 1.033 af

Reach TB-W: West Terrace Bench Avg. Flow Depth=0.31' Max Vel=1.84 fps Inflow=1.18 cfs 0.961 af
n=0.022 L=443.0' S=0.0089 '/' Capacity=297.07 cfs Outflow=1.18 cfs 0.961 af

Total Runoff Area = 4.42 ac Runoff Volume = 2.116 af Average Runoff Depth = 5.74"
100.00% Pervious = 4.42 ac 0.00% Impervious = 0.00 ac

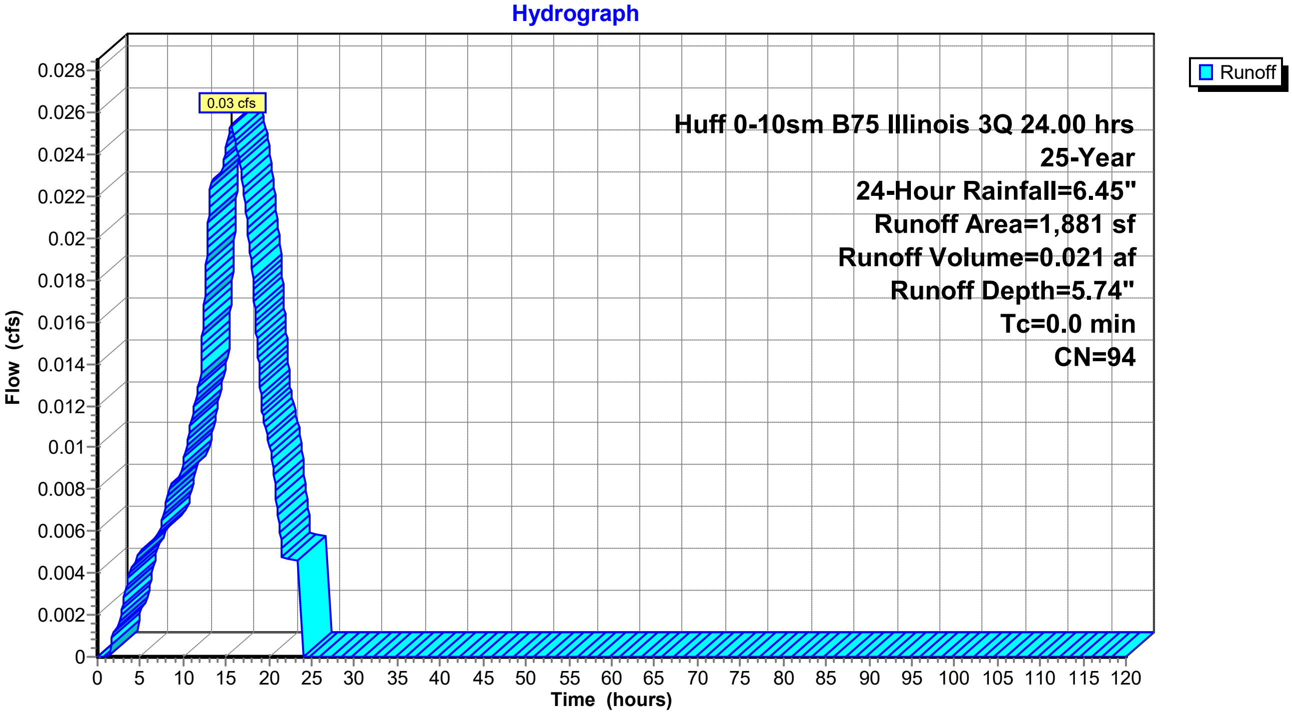
Summary for Subcatchment SC-DC-E-1: Direct Precip (DC-E-1)

Runoff = 0.03 cfs @ 15.60 hrs, Volume= 0.021 af, Depth= 5.74"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Huff 0-10sm B75 Illinois 3Q 24.00 hrs 25-Year, 24-Hour Rainfall=6.45"

Area (sf)	CN	Description
1,881	94	Newly graded area, HSG D
1,881		100.00% Pervious Area

Subcatchment SC-DC-E-1: Direct Precip (DC-E-1)



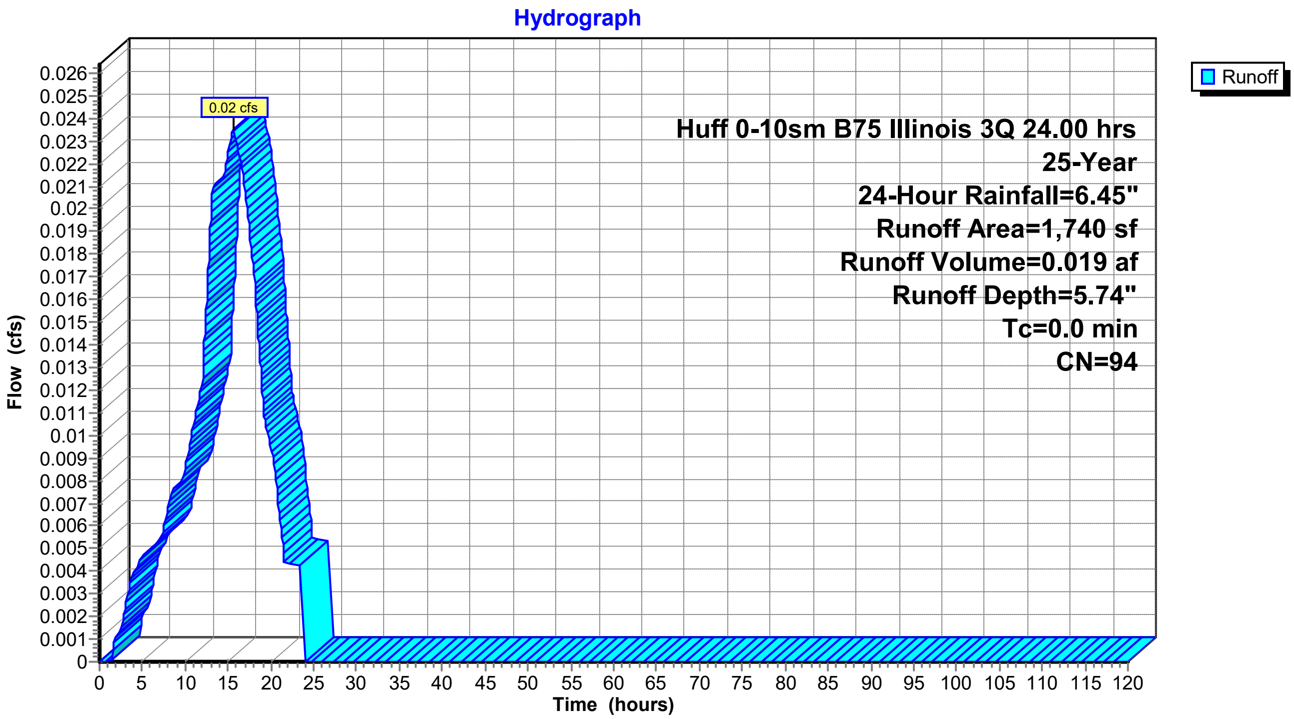
Summary for Subcatchment SC-DC-E-2: Direct Precip (DC-E-2)

Runoff = 0.02 cfs @ 15.60 hrs, Volume= 0.019 af, Depth= 5.74"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Huff 0-10sm B75 Illinois 3Q 24.00 hrs 25-Year, 24-Hour Rainfall=6.45"

Area (sf)	CN	Description
1,740	94	Newly graded area, HSG D
1,740		100.00% Pervious Area

Subcatchment SC-DC-E-2: Direct Precip (DC-E-2)



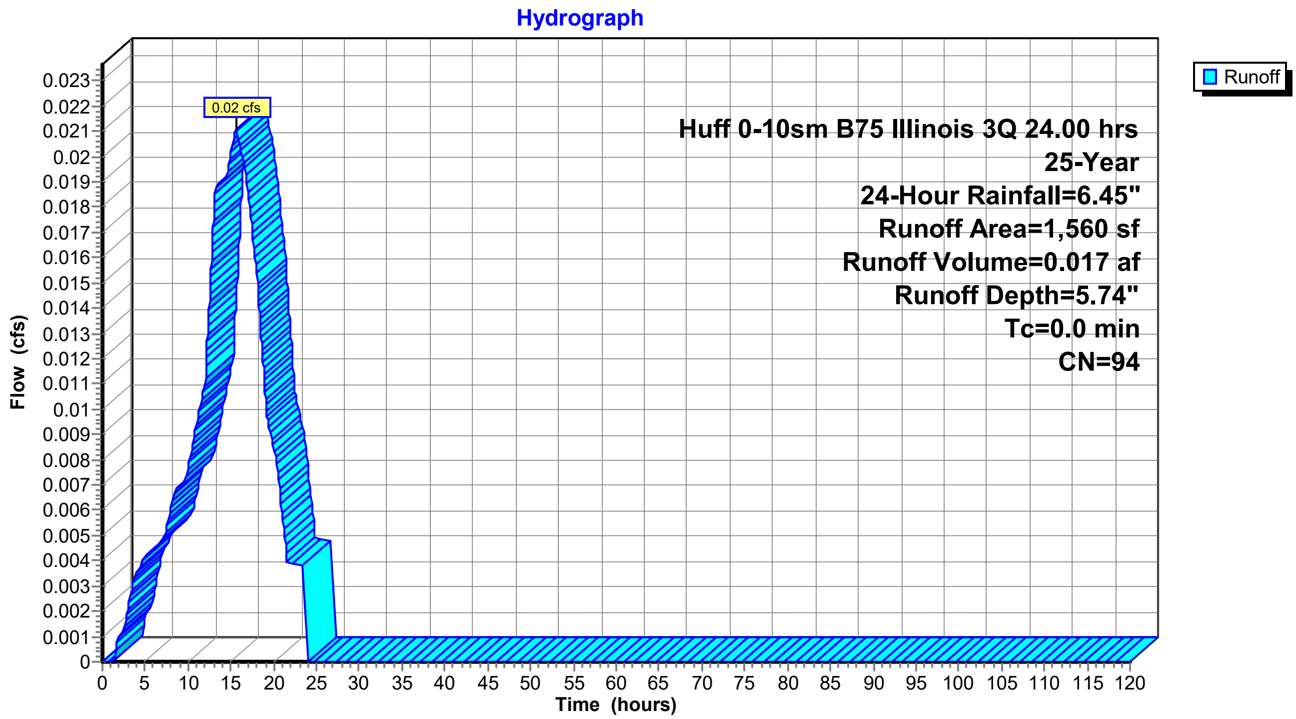
Summary for Subcatchment SC-DC-E-3: Direct Precip (DC-E-3)

Runoff = 0.02 cfs @ 15.60 hrs, Volume= 0.017 af, Depth= 5.74"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Huff 0-10sm B75 Illinois 3Q 24.00 hrs 25-Year, 24-Hour Rainfall=6.45"

Area (sf)	CN	Description
1,560	94	Newly graded area, HSG D
1,560		100.00% Pervious Area

Subcatchment SC-DC-E-3: Direct Precip (DC-E-3)



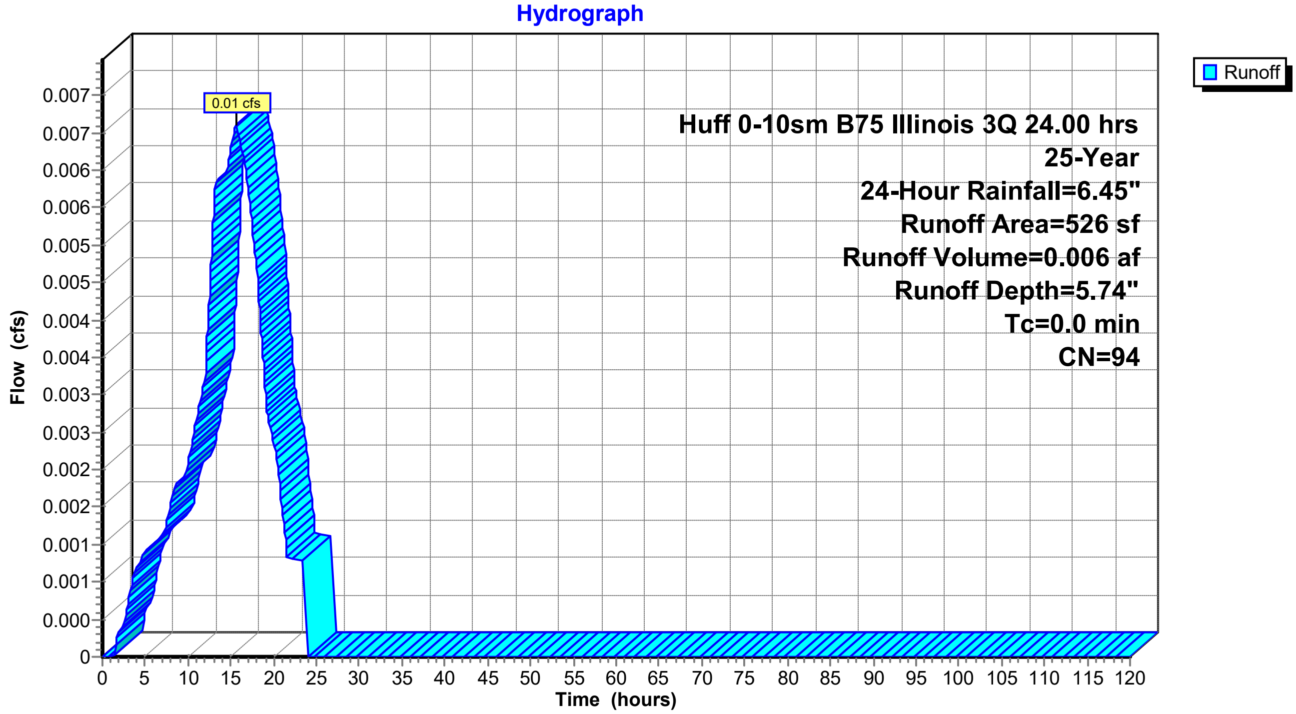
Summary for Subcatchment SC-DC-E-4: Direct Precip (DC-E-4)

Runoff = 0.01 cfs @ 15.60 hrs, Volume= 0.006 af, Depth= 5.74"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Huff 0-10sm B75 Illinois 3Q 24.00 hrs 25-Year, 24-Hour Rainfall=6.45"

Area (sf)	CN	Description
526	94	Newly graded area, HSG D
526		100.00% Pervious Area

Subcatchment SC-DC-E-4: Direct Precip (DC-E-4)



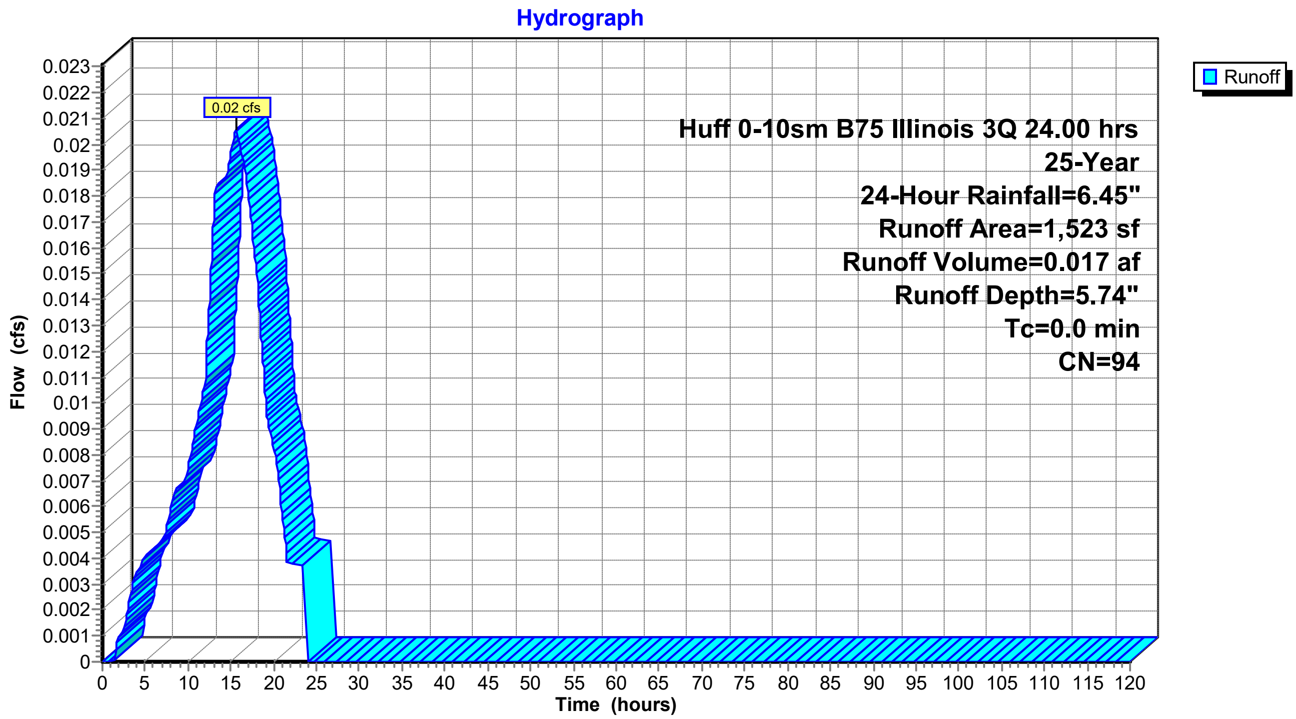
Summary for Subcatchment SC-DC-W-1: Direct Precip (DC-W-1)

Runoff = 0.02 cfs @ 15.60 hrs, Volume= 0.017 af, Depth= 5.74"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Huff 0-10sm B75 Illinois 3Q 24.00 hrs 25-Year, 24-Hour Rainfall=6.45"

Area (sf)	CN	Description
1,523	94	Newly graded area, HSG D
1,523		100.00% Pervious Area

Subcatchment SC-DC-W-1: Direct Precip (DC-W-1)



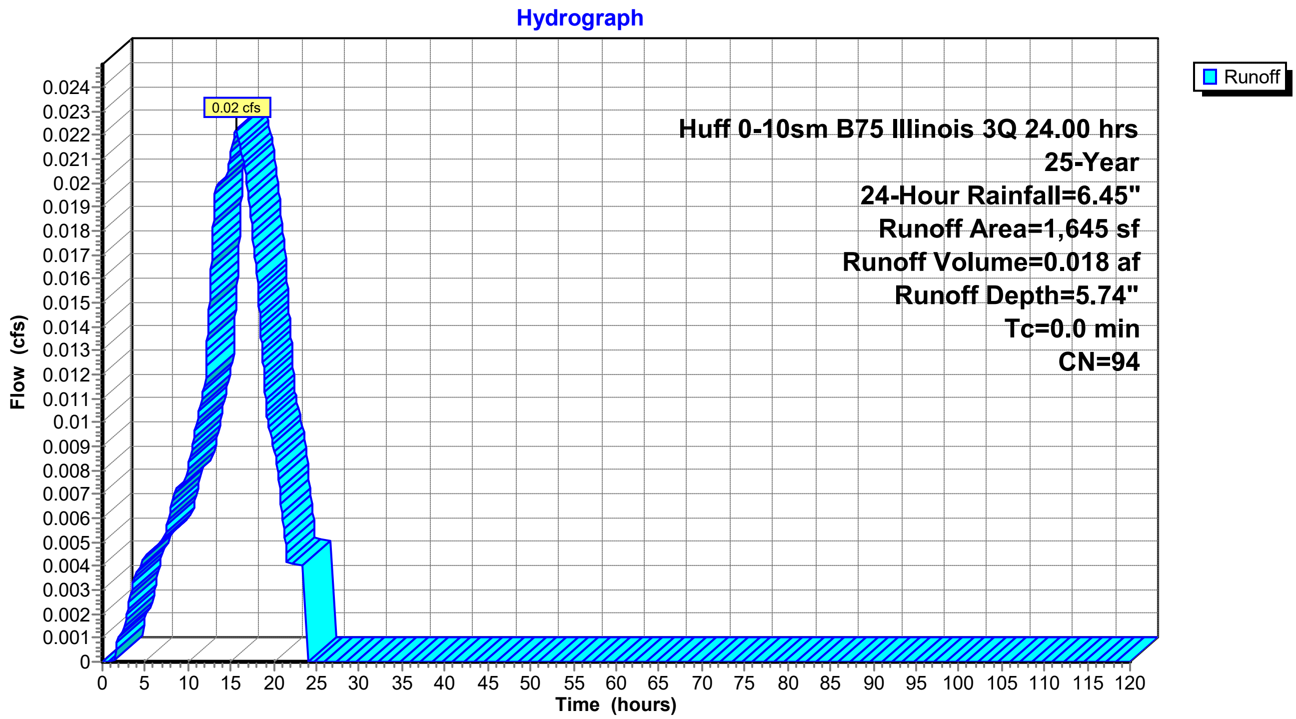
Summary for Subcatchment SC-DC-W-2: Direct Precip (DC-W-2)

Runoff = 0.02 cfs @ 15.60 hrs, Volume= 0.018 af, Depth= 5.74"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Huff 0-10sm B75 Illinois 3Q 24.00 hrs 25-Year, 24-Hour Rainfall=6.45"

Area (sf)	CN	Description
1,645	94	Newly graded area, HSG D
1,645		100.00% Pervious Area

Subcatchment SC-DC-W-2: Direct Precip (DC-W-2)



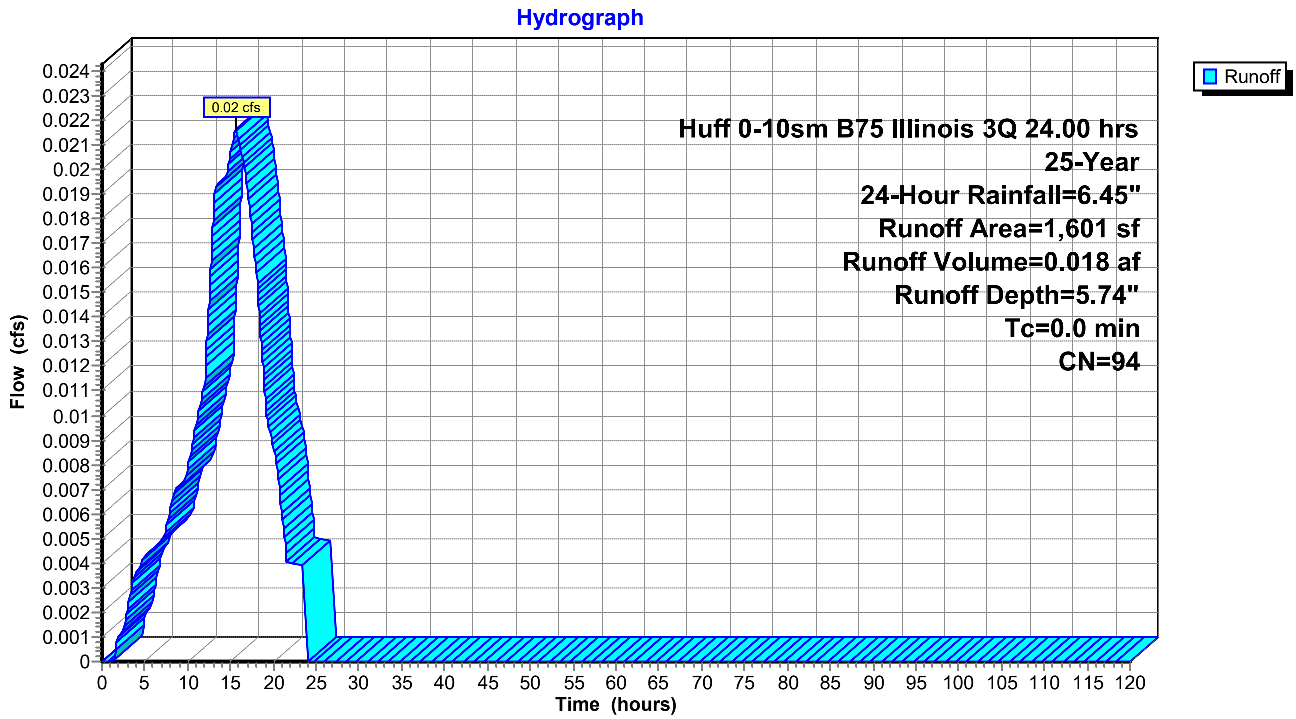
Summary for Subcatchment SC-DC-W-3: Direct Precip (DC-W-3)

Runoff = 0.02 cfs @ 15.60 hrs, Volume= 0.018 af, Depth= 5.74"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Huff 0-10sm B75 Illinois 3Q 24.00 hrs 25-Year, 24-Hour Rainfall=6.45"

Area (sf)	CN	Description
1,601	94	Newly graded area, HSG D
1,601		100.00% Pervious Area

Subcatchment SC-DC-W-3: Direct Precip (DC-W-3)



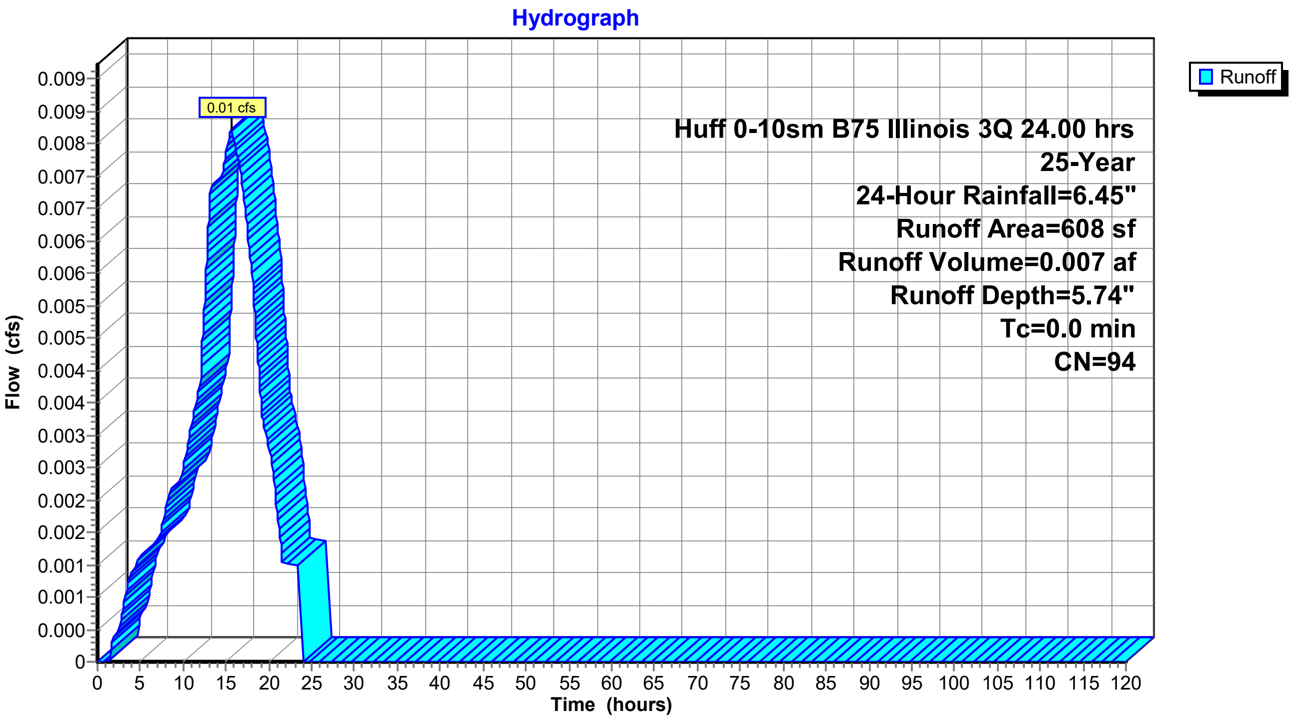
Summary for Subcatchment SC-DC-W-4: Direct Precip (DC-W-4)

Runoff = 0.01 cfs @ 15.60 hrs, Volume= 0.007 af, Depth= 5.74"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Huff 0-10sm B75 Illinois 3Q 24.00 hrs 25-Year, 24-Hour Rainfall=6.45"

Area (sf)	CN	Description
608	94	Newly graded area, HSG D
608		100.00% Pervious Area

Subcatchment SC-DC-W-4: Direct Precip (DC-W-4)



Summary for Subcatchment SC-TB-E: Subcat E Terrace

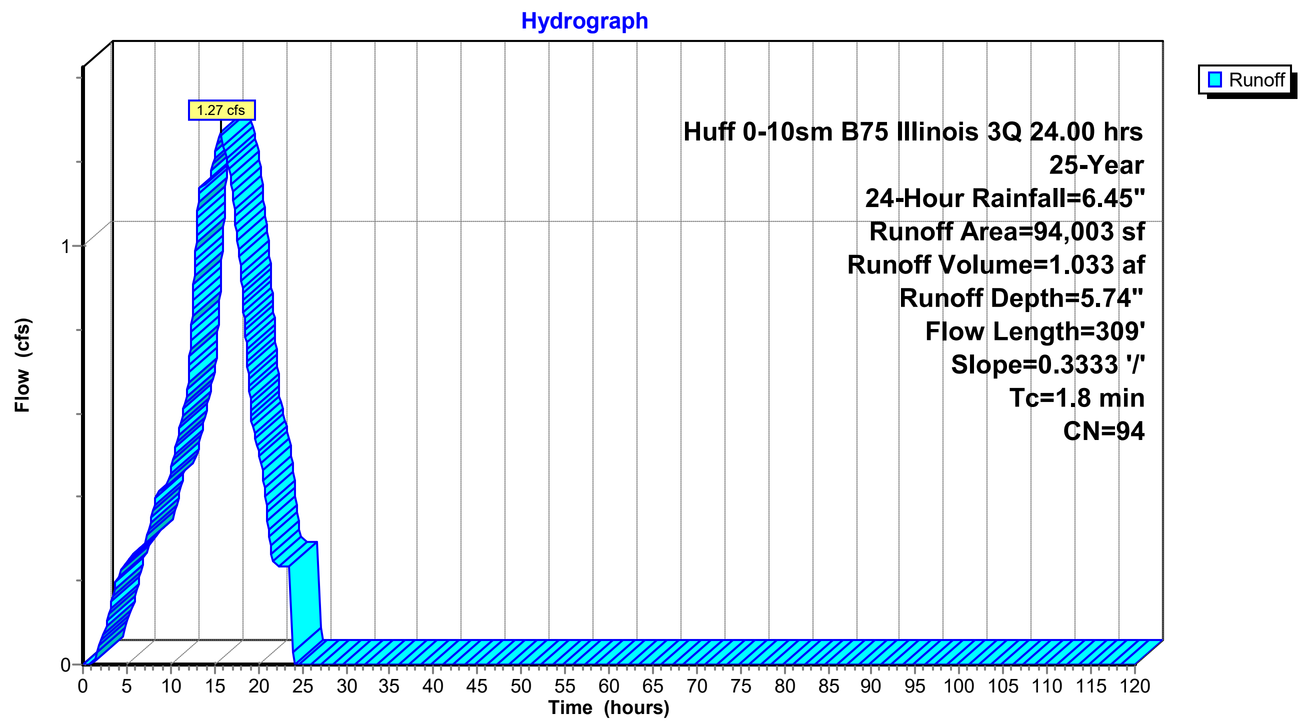
Runoff = 1.27 cfs @ 15.63 hrs, Volume= 1.033 af, Depth= 5.74"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Huff 0-10sm B75 Illinois 3Q 24.00 hrs 25-Year, 24-Hour Rainfall=6.45"

Area (sf)	CN	Description
94,003	94	Newly graded area, HSG D
94,003		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.4	100	0.3333	1.18		**Sheet Flow,** Fallow n= 0.050 P2= 2.80"
0.4	209	0.3333	9.29		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
1.8	309	Total			

Subcatchment SC-TB-E: Subcat E Terrace



Summary for Subcatchment SC-TB-W: Subcat W Terrace

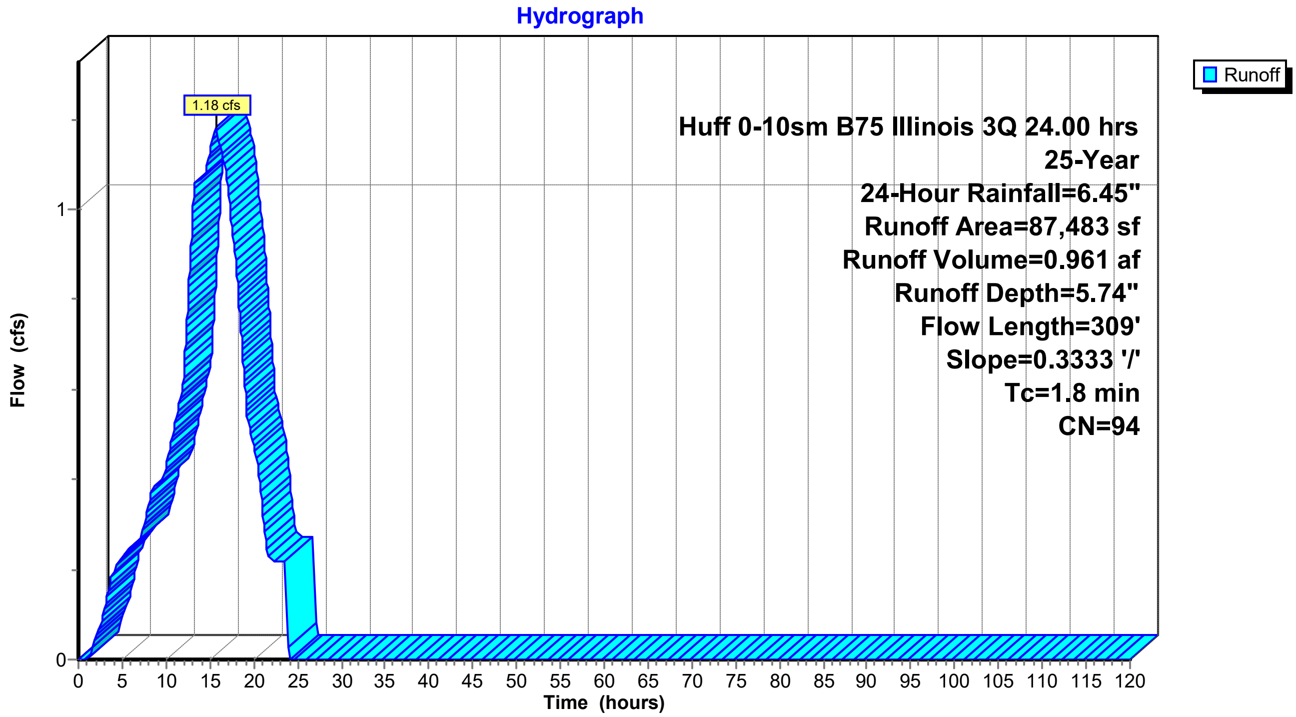
Runoff = 1.18 cfs @ 15.63 hrs, Volume= 0.961 af, Depth= 5.74"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Huff 0-10sm B75 Illinois 3Q 24.00 hrs 25-Year, 24-Hour Rainfall=6.45"

Area (sf)	CN	Description
87,483	94	Newly graded area, HSG D
87,483		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.4	100	0.3333	1.18		**Sheet Flow,** Fallow n= 0.050 P2= 2.80"
0.4	209	0.3333	9.29		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
1.8	309	Total			

Subcatchment SC-TB-W: Subcat W Terrace



Summary for Reach DC-E-1: East Downchute Seg 1

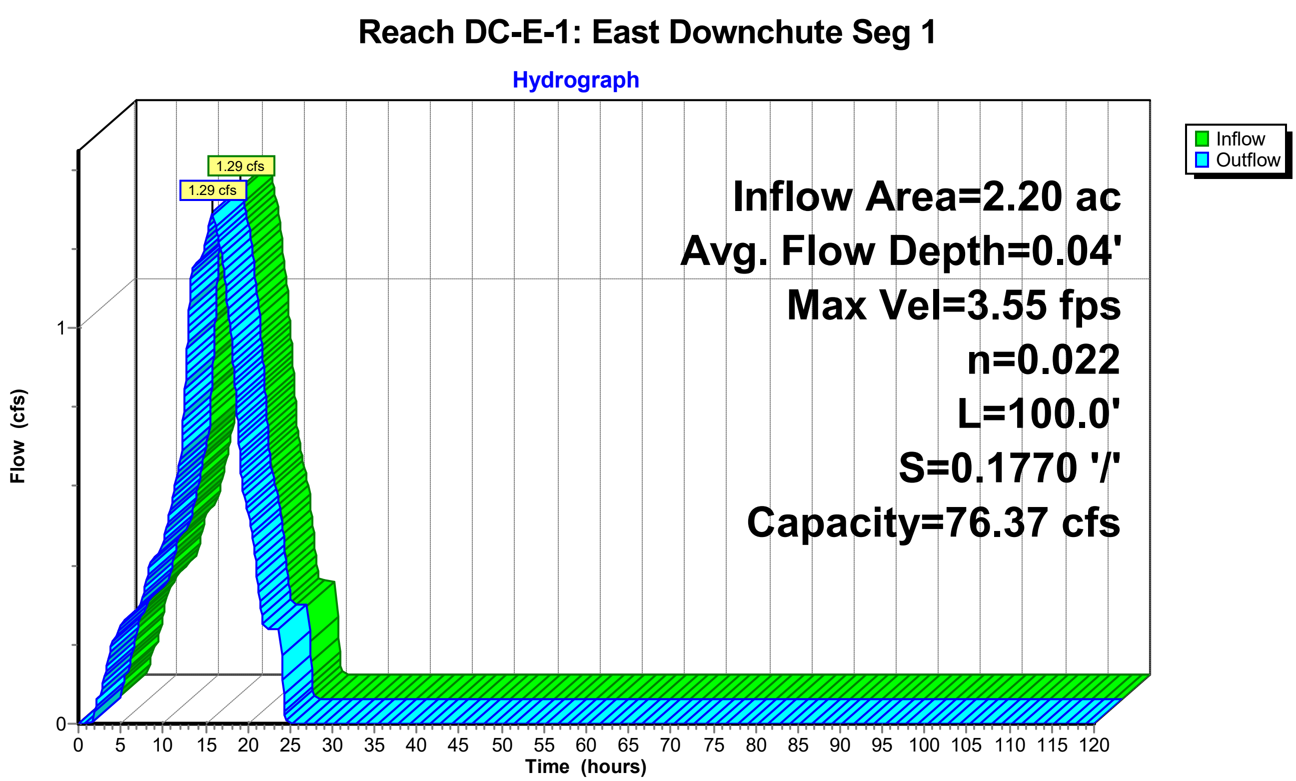
Inflow Area = 2.20 ac, 0.00% Impervious, Inflow Depth = 5.74" for 25-Year, 24-Hour event
Inflow = 1.29 cfs @ 15.75 hrs, Volume= 1.053 af
Outflow = 1.29 cfs @ 15.77 hrs, Volume= 1.053 af, Atten= 0%, Lag= 0.7 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.55 fps, Min. Travel Time= 0.5 min
Avg. Velocity = 2.28 fps, Avg. Travel Time= 0.7 min

Peak Storage= 36 cf @ 15.76 hrs
Average Depth at Peak Storage= 0.04'
Bank-Full Depth= 0.50' Flow Area= 4.8 sf, Capacity= 76.37 cfs

8.00' x 0.50' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 3.0 '/' Top Width= 11.00'
Length= 100.0' Slope= 0.1770 '/'
Inlet Invert= 795.46', Outlet Invert= 777.76'

‡



Summary for Reach DC-E-2: East Downchute Seg 2

Inflow Area = 2.24 ac, 0.00% Impervious, Inflow Depth = 5.74" for 25-Year, 24-Hour event
Inflow = 1.32 cfs @ 15.77 hrs, Volume= 1.072 af
Outflow = 1.32 cfs @ 15.78 hrs, Volume= 1.072 af, Atten= 0%, Lag= 0.8 min

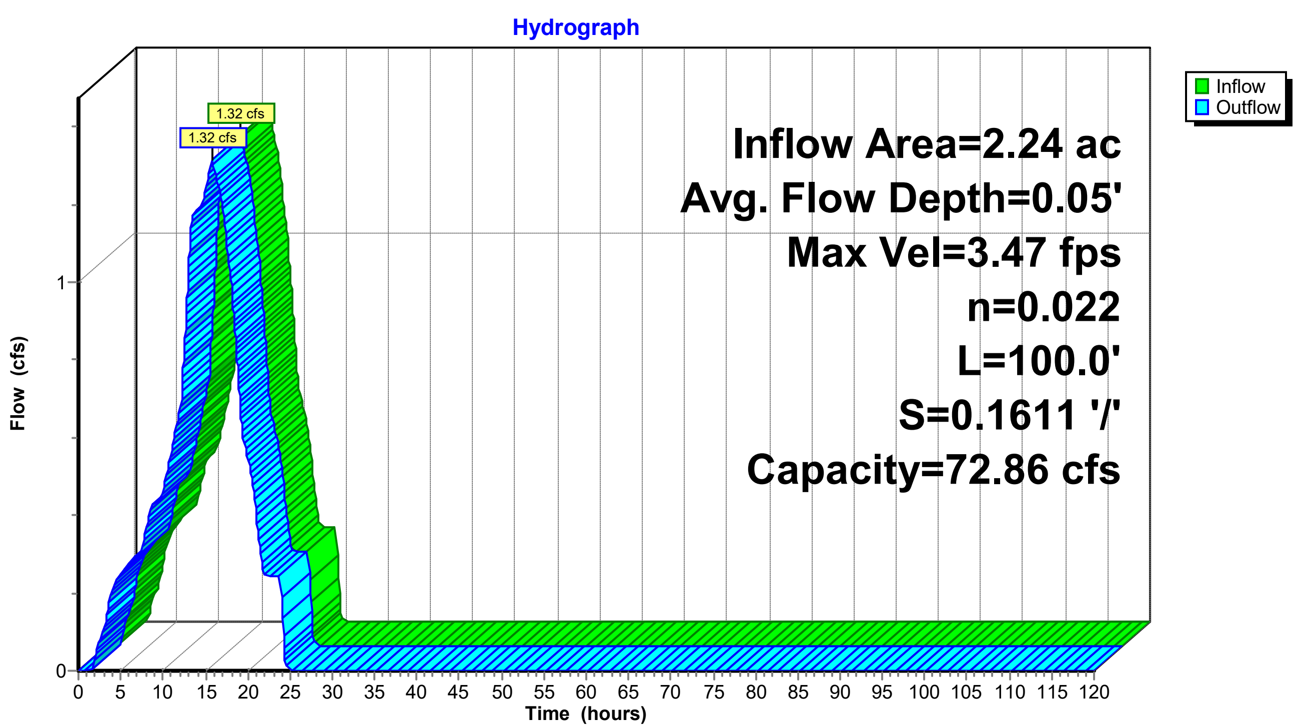
Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.47 fps, Min. Travel Time= 0.5 min
Avg. Velocity = 2.22 fps, Avg. Travel Time= 0.8 min

Peak Storage= 38 cf @ 15.77 hrs
Average Depth at Peak Storage= 0.05'
Bank-Full Depth= 0.50' Flow Area= 4.8 sf, Capacity= 72.86 cfs

8.00' x 0.50' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 3.0 '/' Top Width= 11.00'
Length= 100.0' Slope= 0.1611 '/'
Inlet Invert= 777.76', Outlet Invert= 761.65'

‡

Reach DC-E-2: East Downchute Seg 2



Summary for Reach DC-E-3: East Downchute Seg 3

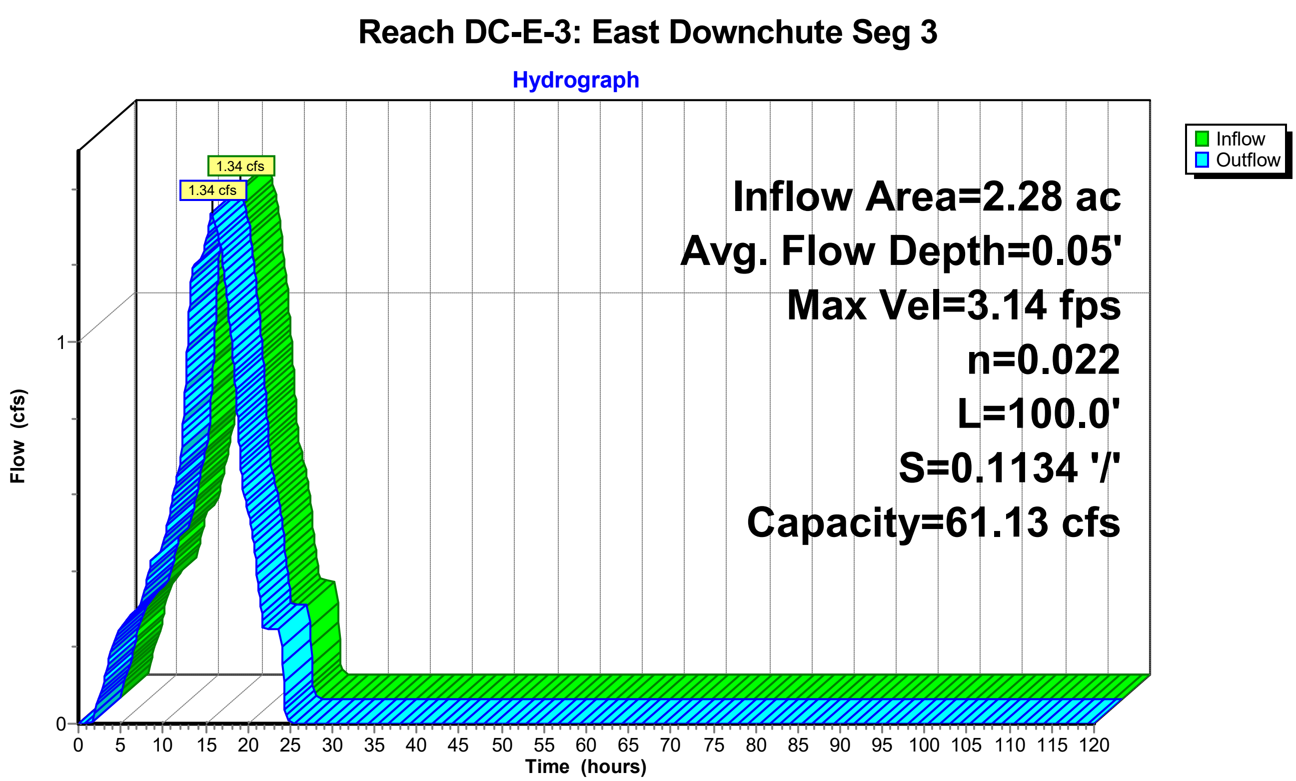
Inflow Area = 2.28 ac, 0.00% Impervious, Inflow Depth = 5.74" for 25-Year, 24-Hour event
Inflow = 1.34 cfs @ 15.78 hrs, Volume= 1.090 af
Outflow = 1.34 cfs @ 15.79 hrs, Volume= 1.090 af, Atten= 0%, Lag= 0.9 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.14 fps, Min. Travel Time= 0.5 min
Avg. Velocity = 2.00 fps, Avg. Travel Time= 0.8 min

Peak Storage= 43 cf @ 15.78 hrs
Average Depth at Peak Storage= 0.05'
Bank-Full Depth= 0.50' Flow Area= 4.8 sf, Capacity= 61.13 cfs

8.00' x 0.50' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 3.0 '/' Top Width= 11.00'
Length= 100.0' Slope= 0.1134 '/'
Inlet Invert= 761.65', Outlet Invert= 750.31'

‡



Summary for Reach DC-E-4: East Downchute Seg 4

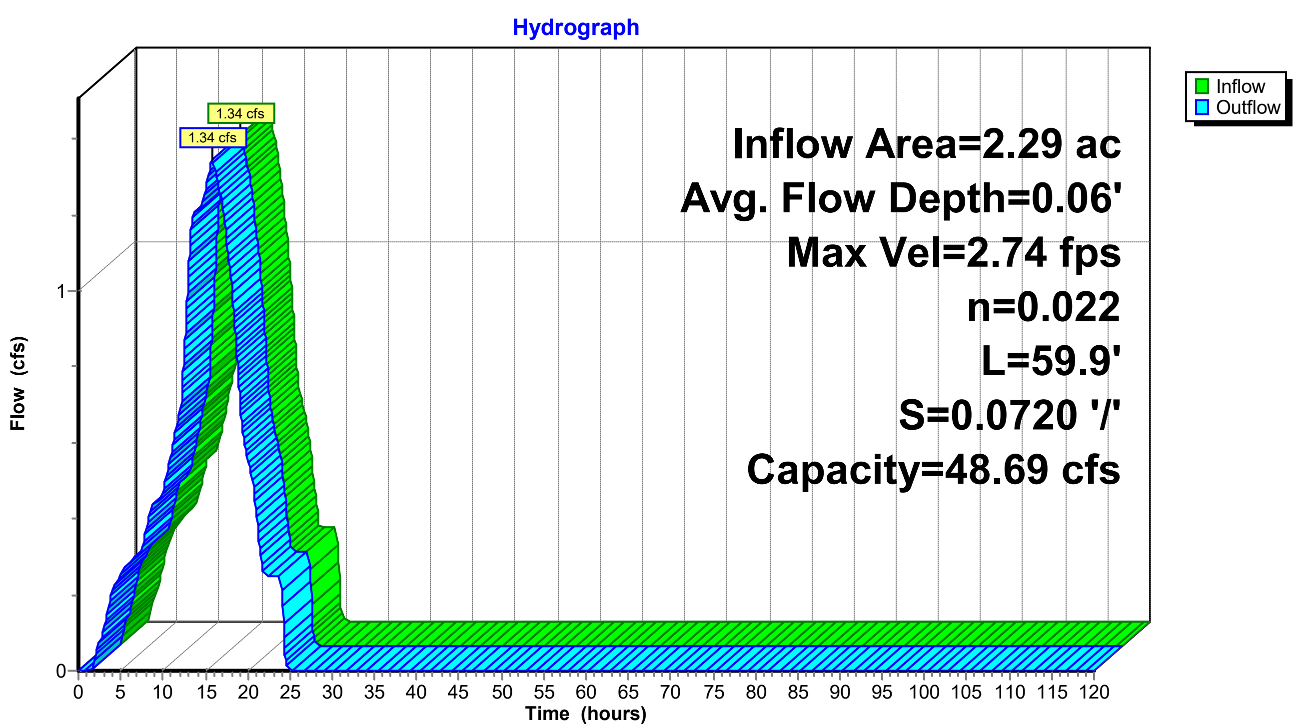
Inflow Area = 2.29 ac, 0.00% Impervious, Inflow Depth = 5.74" for 25-Year, 24-Hour event
Inflow = 1.34 cfs @ 15.79 hrs, Volume= 1.095 af
Outflow = 1.34 cfs @ 15.80 hrs, Volume= 1.095 af, Atten= 0%, Lag= 0.6 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.74 fps, Min. Travel Time= 0.4 min
Avg. Velocity = 1.73 fps, Avg. Travel Time= 0.6 min

Peak Storage= 29 cf @ 15.80 hrs
Average Depth at Peak Storage= 0.06'
Bank-Full Depth= 0.50' Flow Area= 4.8 sf, Capacity= 48.69 cfs

8.00' x 0.50' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 3.0 '/' Top Width= 11.00'
Length= 59.9' Slope= 0.0720 '/'
Inlet Invert= 750.31', Outlet Invert= 746.00'

Reach DC-E-4: East Downchute Seg 4



Summary for Reach DC-W-1: West Downchute Seg 1

Inflow Area = 2.04 ac, 0.00% Impervious, Inflow Depth = 5.74" for 25-Year, 24-Hour event
Inflow = 1.20 cfs @ 15.74 hrs, Volume= 0.978 af
Outflow = 1.20 cfs @ 15.76 hrs, Volume= 0.978 af, Atten= 0%, Lag= 0.8 min

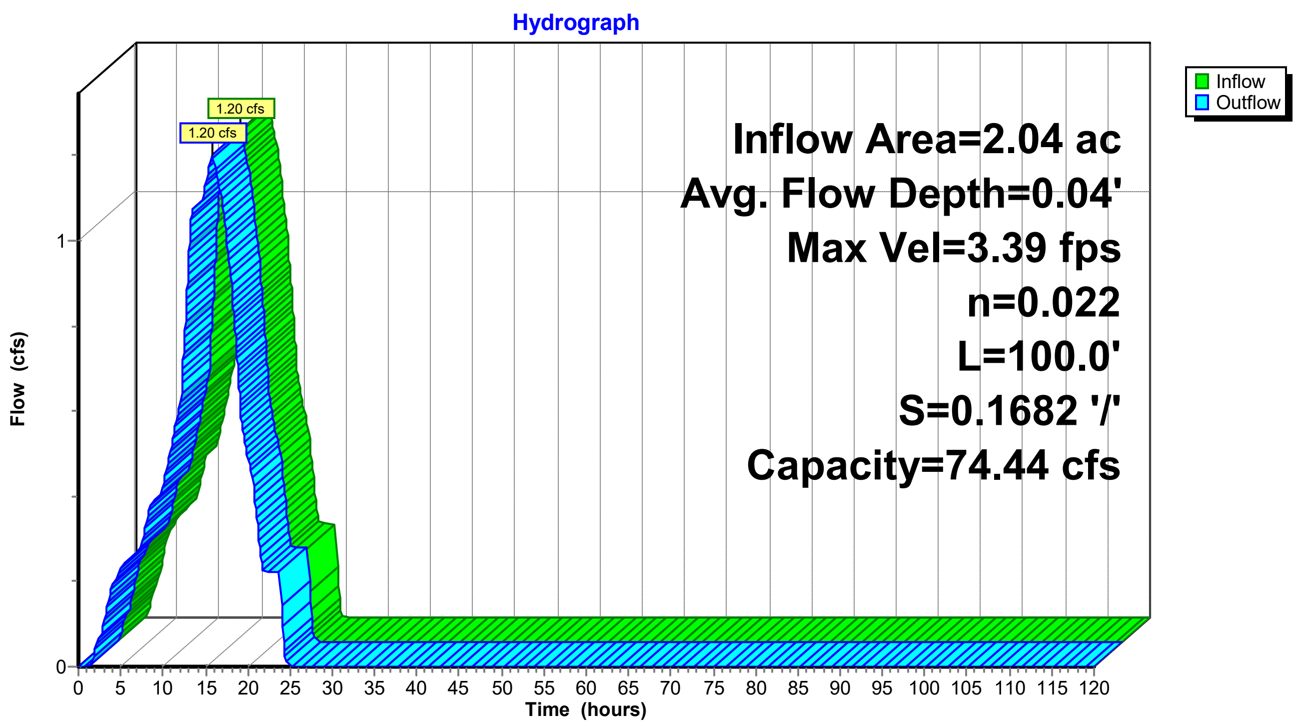
Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.39 fps, Min. Travel Time= 0.5 min
Avg. Velocity = 2.19 fps, Avg. Travel Time= 0.8 min

Peak Storage= 35 cf @ 15.75 hrs
Average Depth at Peak Storage= 0.04'
Bank-Full Depth= 0.50' Flow Area= 4.8 sf, Capacity= 74.44 cfs

8.00' x 0.50' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 3.0 '/' Top Width= 11.00'
Length= 100.0' Slope= 0.1682 '/'
Inlet Invert= 796.00', Outlet Invert= 779.18'

‡

Reach DC-W-1: West Downchute Seg 1



Summary for Reach DC-W-2: West Downchute Seg 2

Inflow Area = 2.08 ac, 0.00% Impervious, Inflow Depth = 5.74" for 25-Year, 24-Hour event
Inflow = 1.22 cfs @ 15.76 hrs, Volume= 0.996 af
Outflow = 1.22 cfs @ 15.77 hrs, Volume= 0.996 af, Atten= 0%, Lag= 0.8 min

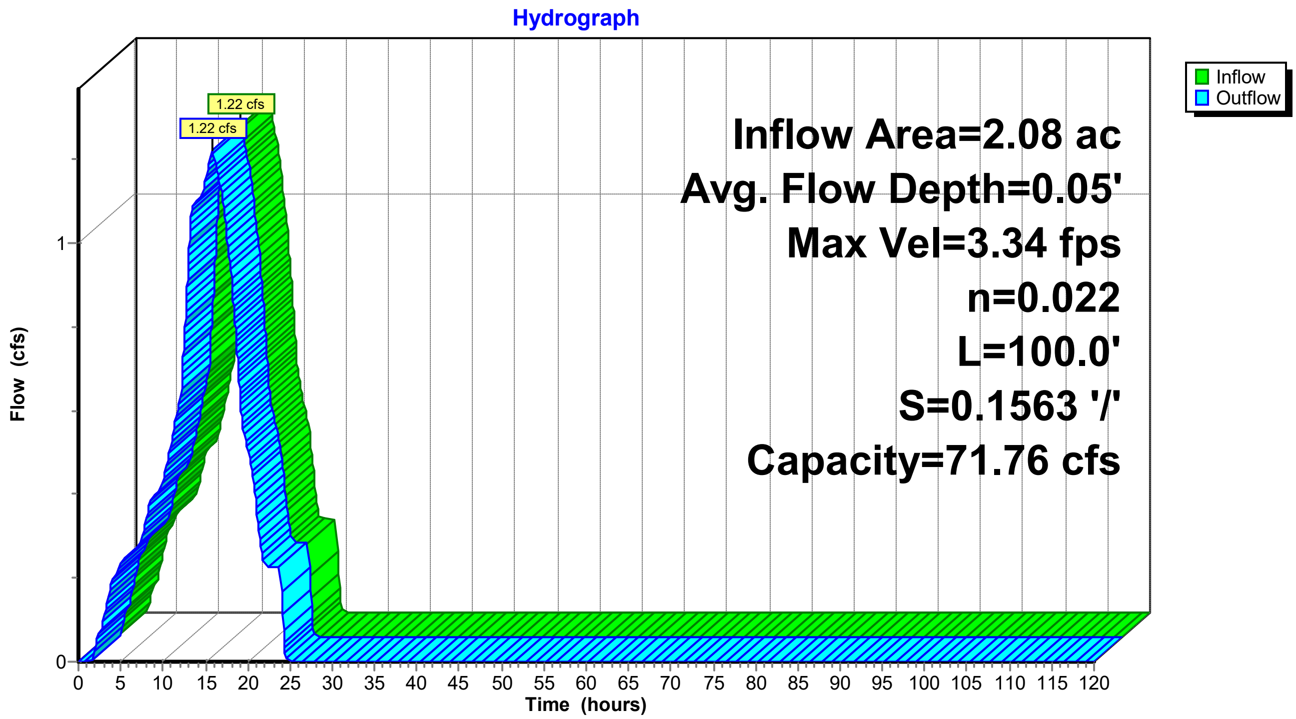
Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.34 fps, Min. Travel Time= 0.5 min
Avg. Velocity = 2.15 fps, Avg. Travel Time= 0.8 min

Peak Storage= 37 cf @ 15.76 hrs
Average Depth at Peak Storage= 0.05'
Bank-Full Depth= 0.50' Flow Area= 4.8 sf, Capacity= 71.76 cfs

8.00' x 0.50' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 3.0 '/' Top Width= 11.00'
Length= 100.0' Slope= 0.1563 '/'
Inlet Invert= 779.18', Outlet Invert= 763.55'

‡

Reach DC-W-2: West Downchute Seg 2



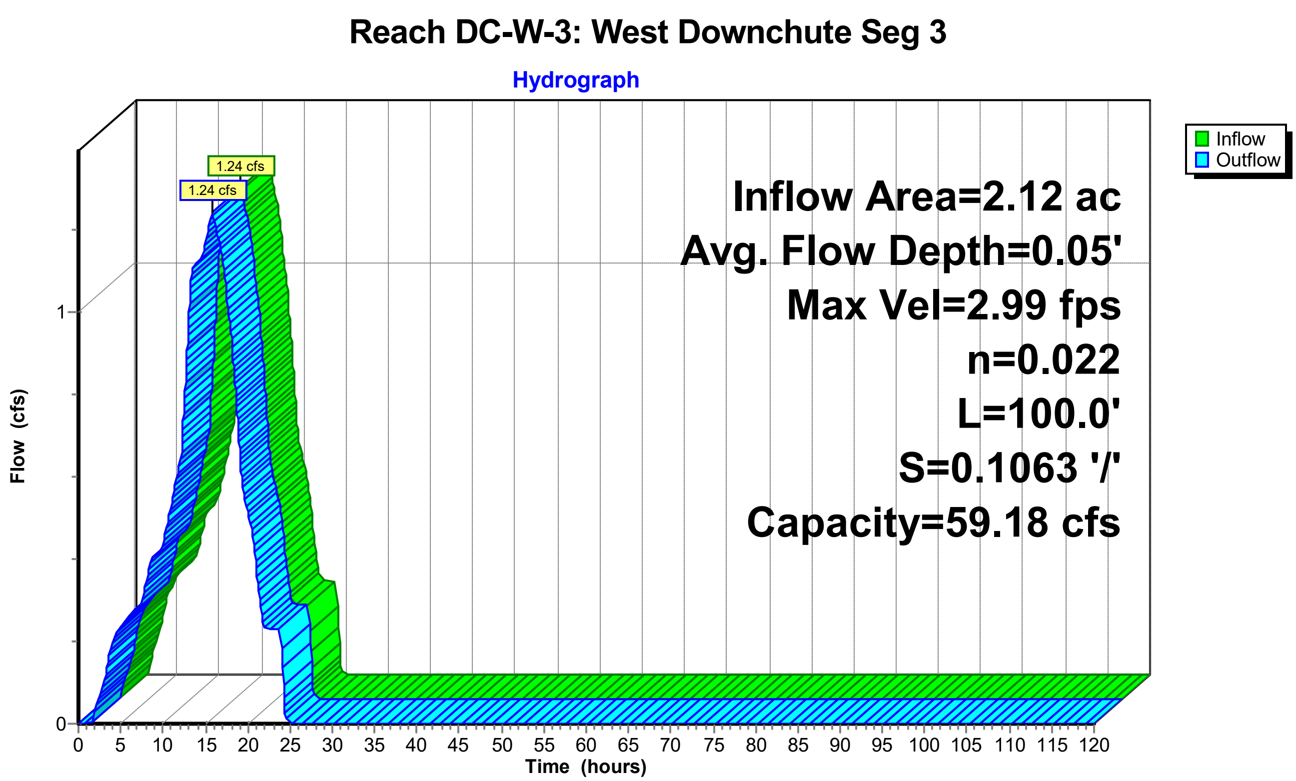
Summary for Reach DC-W-3: West Downchute Seg 3

Inflow Area = 2.12 ac, 0.00% Impervious, Inflow Depth = 5.74" for 25-Year, 24-Hour event
Inflow = 1.24 cfs @ 15.77 hrs, Volume= 1.013 af
Outflow = 1.24 cfs @ 15.78 hrs, Volume= 1.013 af, Atten= 0%, Lag= 1.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.99 fps, Min. Travel Time= 0.6 min
Avg. Velocity = 1.92 fps, Avg. Travel Time= 0.9 min

Peak Storage= 42 cf @ 15.77 hrs
Average Depth at Peak Storage= 0.05'
Bank-Full Depth= 0.50' Flow Area= 4.8 sf, Capacity= 59.18 cfs

8.00' x 0.50' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 3.0 '/' Top Width= 11.00'
Length= 100.0' Slope= 0.1063 '/'
Inlet Invert= 763.55', Outlet Invert= 752.92'



Summary for Reach DC-W-4: West Downchute Seg 4

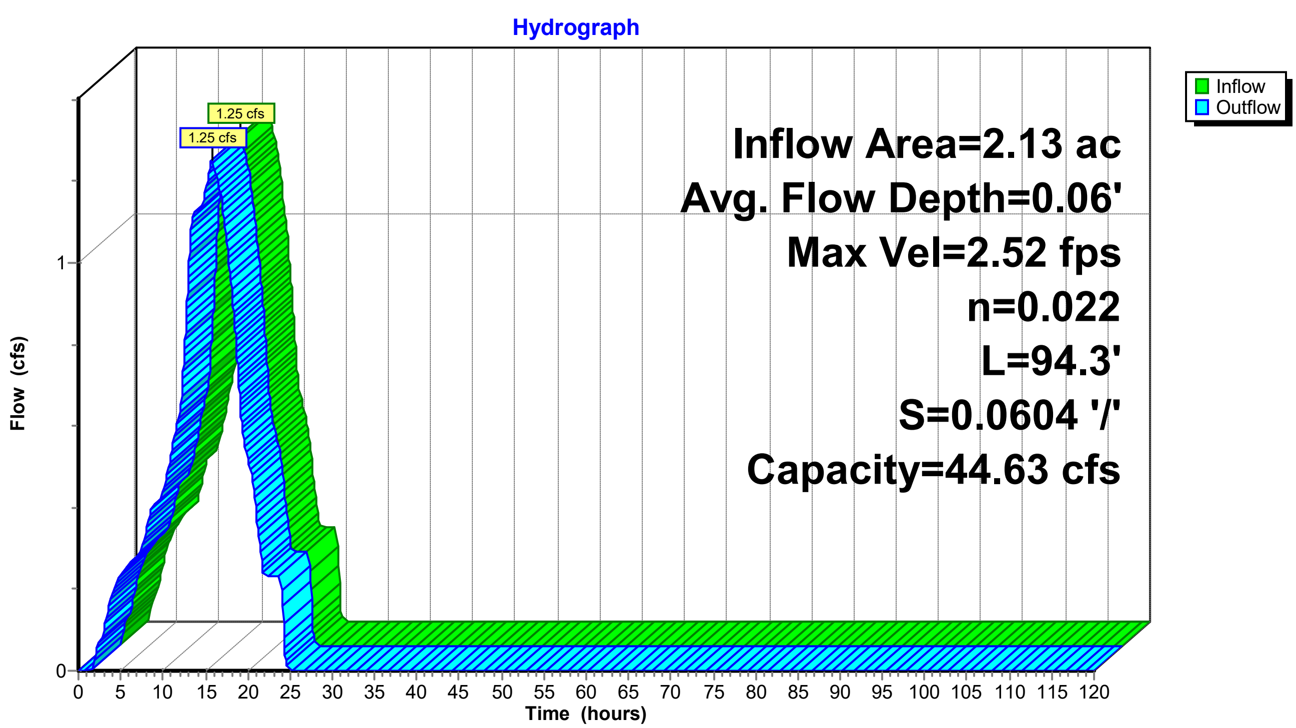
Inflow Area = 2.13 ac, 0.00% Impervious, Inflow Depth = 5.74" for 25-Year, 24-Hour event
Inflow = 1.25 cfs @ 15.78 hrs, Volume= 1.020 af
Outflow = 1.25 cfs @ 15.80 hrs, Volume= 1.020 af, Atten= 0%, Lag= 1.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.52 fps, Min. Travel Time= 0.6 min
Avg. Velocity = 1.60 fps, Avg. Travel Time= 1.0 min

Peak Storage= 47 cf @ 15.79 hrs
Average Depth at Peak Storage= 0.06'
Bank-Full Depth= 0.50' Flow Area= 4.8 sf, Capacity= 44.63 cfs

8.00' x 0.50' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 3.0 '/' Top Width= 11.00'
Length= 94.3' Slope= 0.0604 '/'
Inlet Invert= 752.92', Outlet Invert= 747.22'

Reach DC-W-4: West Downchute Seg 4



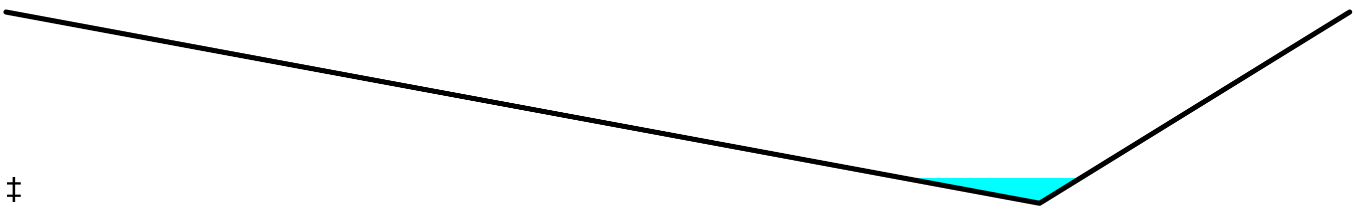
Summary for Reach TB-E: East Terrace Bench

Inflow Area = 2.16 ac, 0.00% Impervious, Inflow Depth = 5.74" for 25-Year, 24-Hour event
Inflow = 1.27 cfs @ 15.63 hrs, Volume= 1.033 af
Outflow = 1.27 cfs @ 15.76 hrs, Volume= 1.033 af, Atten= 0%, Lag= 7.4 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.82 fps, Min. Travel Time= 4.5 min
Avg. Velocity = 1.31 fps, Avg. Travel Time= 6.2 min

Peak Storage= 340 cf @ 15.68 hrs
Average Depth at Peak Storage= 0.33'
Bank-Full Depth= 2.50' Flow Area= 40.6 sf, Capacity= 285.77 cfs

0.00' x 2.50' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 10.0 3.0 '/' Top Width= 32.50'
Length= 486.0' Slope= 0.0082 '/'
Inlet Invert= 800.00', Outlet Invert= 796.00'



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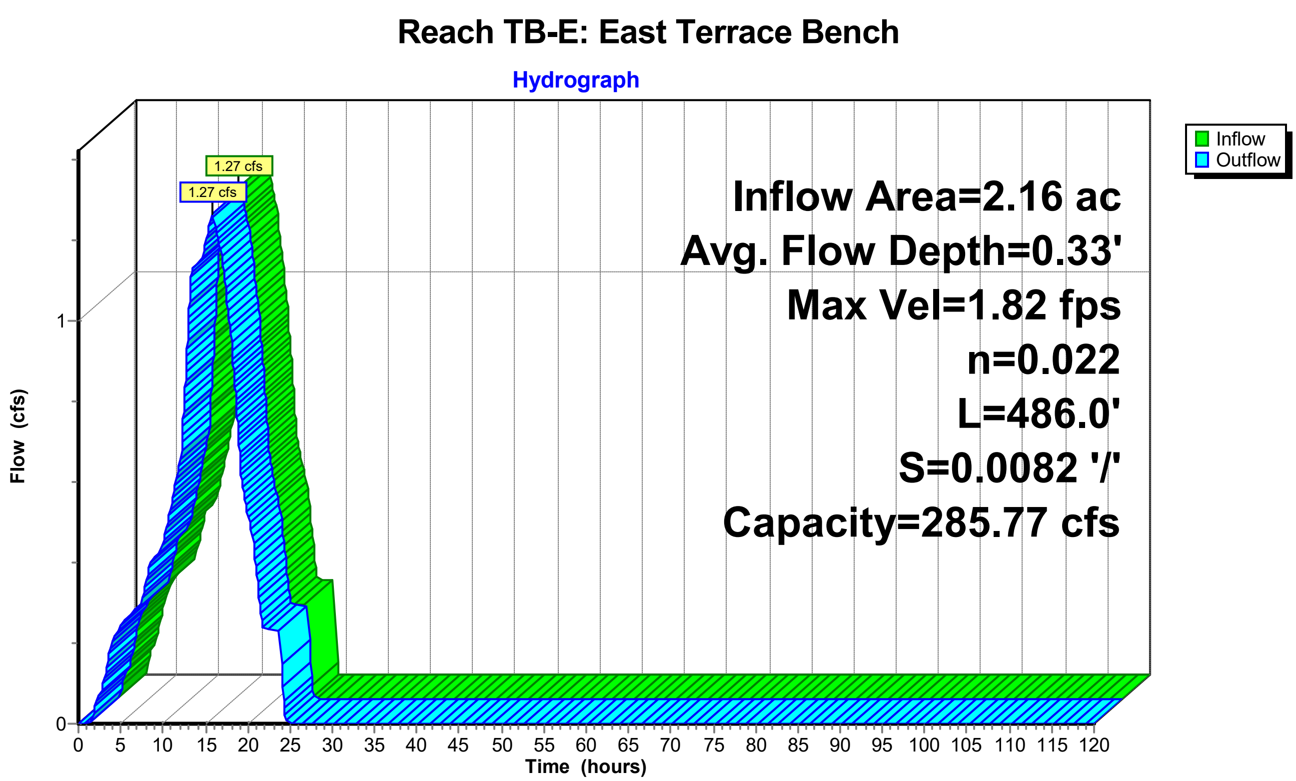


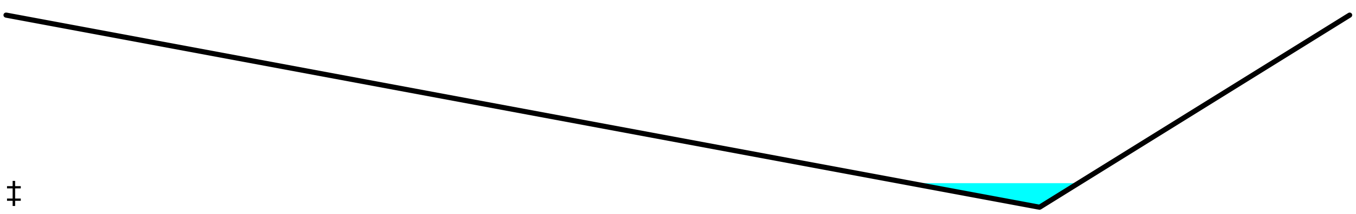
Summary for Reach TB-W: West Terrace Bench

Inflow Area = 2.01 ac, 0.00% Impervious, Inflow Depth = 5.74" for 25-Year, 24-Hour event
Inflow = 1.18 cfs @ 15.63 hrs, Volume= 0.961 af
Outflow = 1.18 cfs @ 15.75 hrs, Volume= 0.961 af, Atten= 0%, Lag= 6.8 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.84 fps, Min. Travel Time= 4.0 min
Avg. Velocity = 1.33 fps, Avg. Travel Time= 5.5 min

Peak Storage= 285 cf @ 15.68 hrs
Average Depth at Peak Storage= 0.31'
Bank-Full Depth= 2.50' Flow Area= 40.6 sf, Capacity= 297.07 cfs

0.00' x 2.50' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 10.0 3.0 '/' Top Width= 32.50'
Length= 443.0' Slope= 0.0089 '/'
Inlet Invert= 800.00', Outlet Invert= 796.06'



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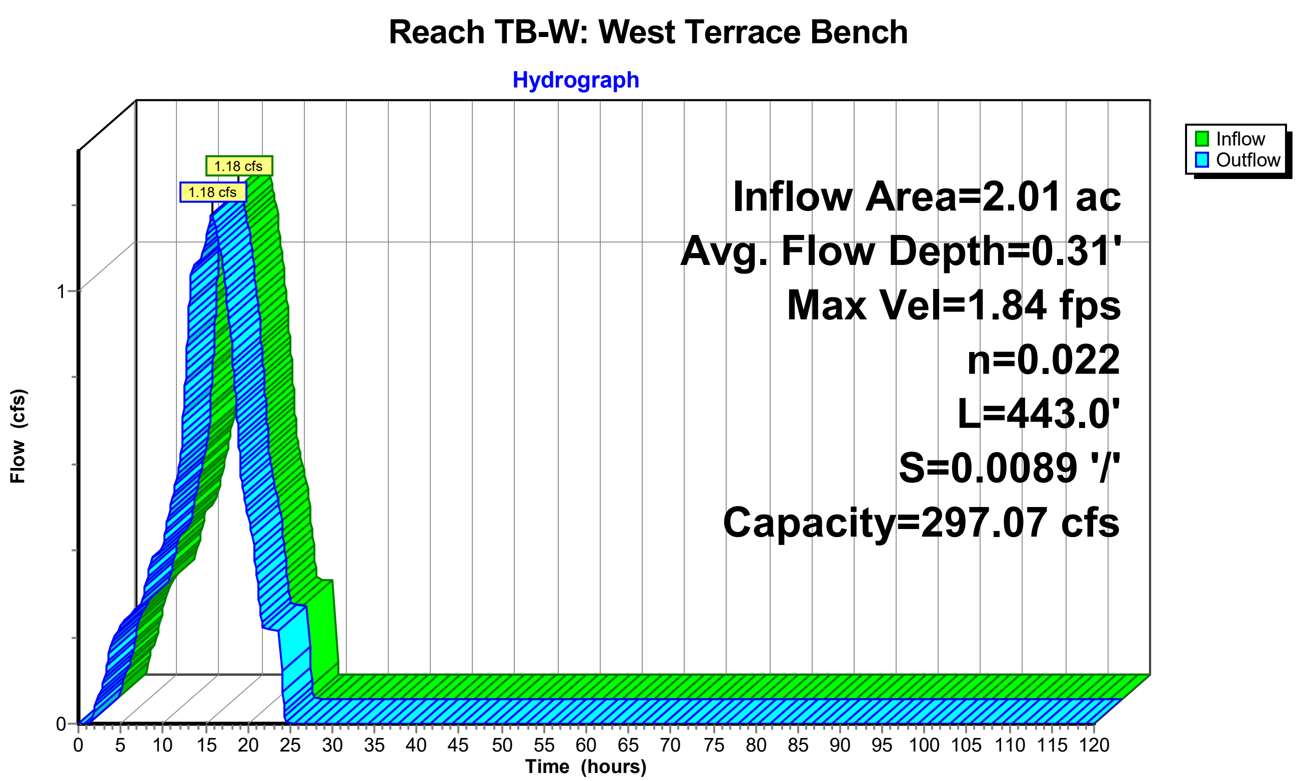
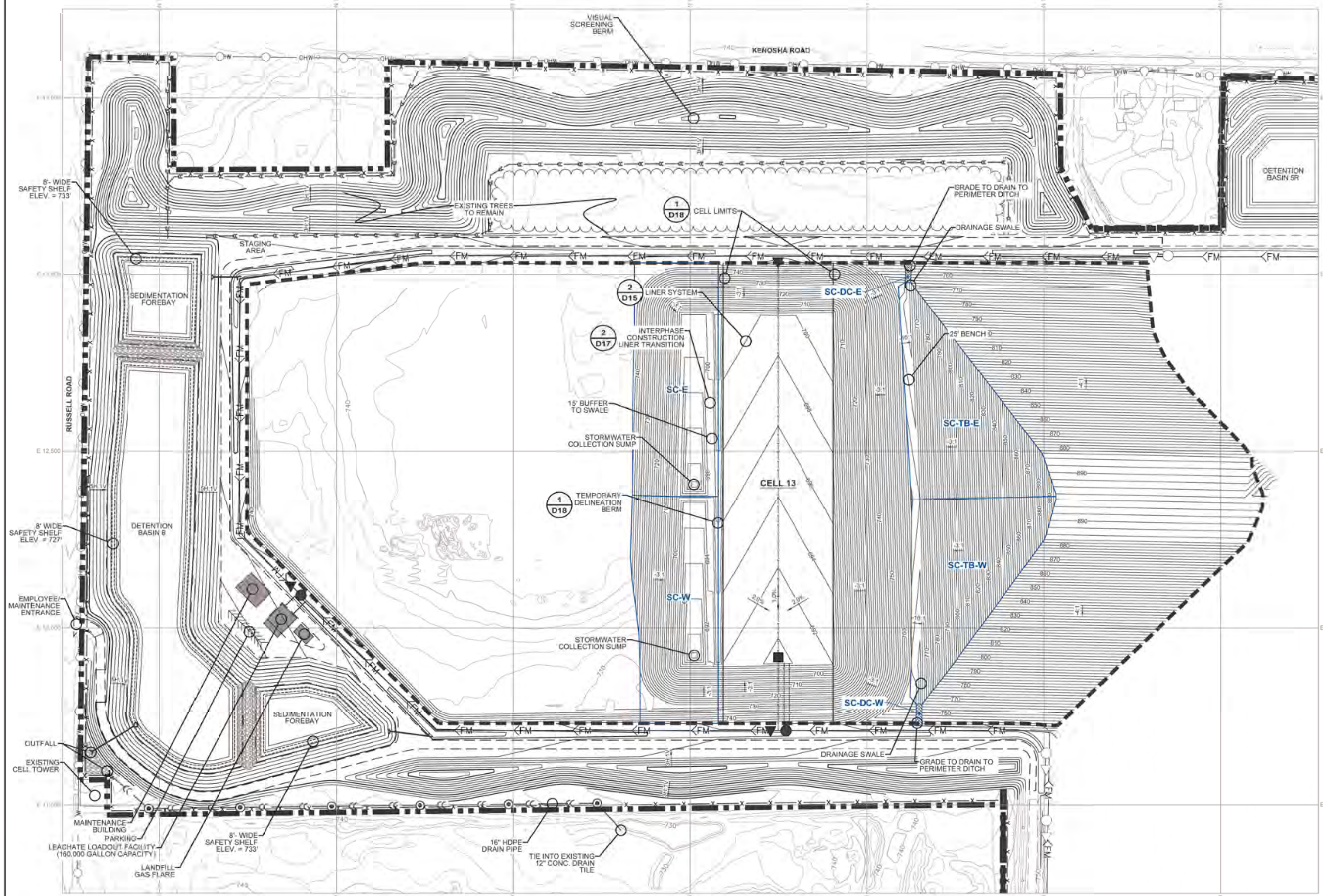
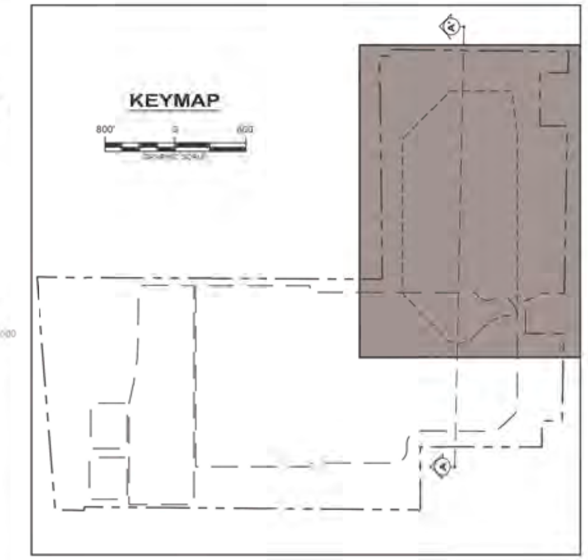


Phase C
25-year, 24-hour HydroCAD Outputs



KEYMAP



LEGEND

- APPROXIMATE FACILITY BOUNDARY
- APPROXIMATE EXISTING WASTE BOUNDARY
- APPROXIMATE PROPOSED EXPANSION WASTE BOUNDARY
- EXISTING CONTOUR
- EXISTING ROAD
- EXISTING VEGETATION
- EXISTING FENCE
- EXISTING CULVERT
- PROPOSED GROUND SURFACE ELEVATION CONTOUR (FEET-MSL)
- PROPOSED ROAD
- PROPOSED CULVERT
- EXISTING FORCEMAIN
- EXISTING LEACHATE COLLECTION PIPE
- EXISTING LEACHATE CLEANOUT LOCATION
- EXISTING LEACHATE VAULT LOCATION
- EXISTING LEACHATE COLLECTION SUMP LOCATION
- PROPOSED FORCEMAIN
- PROPOSED LEACHATE COLLECTION PIPE
- PROPOSED LEACHATE CLEANOUT LOCATION
- PROPOSED LEACHATE VAULT/MANHOLE LOCATION
- PROPOSED LEACHATE COLLECTION SUMP LOCATION
- PROPOSED DRAIN TILE
- STORMWATER MANHOLE
- STORMWATER HEADWALL
- SUBCATCHMENT BOUNDARY

NOTES

1. EXISTING CONTOURS DEVELOPED FROM SITE AERIAL TOPOGRAPHIC SURVEY BY CQM, INC. ON 10/22/2018 EXCEPT STORMWATER MANAGEMENT FEATURES ASSOCIATED WITH SITE 2 EAST (DITCHES AND BASIN 5R). STORMWATER DESIGN GRADES ARE SHOWN FOR THESE FEATURES FOR COMPLETENESS, AS NOT ALL GRADES ARE CAPTURED BY THE TOPOGRAPHIC SURVEY.
2. CURRENT TOPOGRAPHY MAY DIFFER FROM THAT SHOWN.
3. FOR CLARITY, NOT ALL SITE FEATURES MAY BE SHOWN.
4. CELL DEVELOPMENT WILL PROCEED IN NUMERICAL ORDER. VERTICAL EXPANSION WILL PROGRESS CONCURRENT WITH CELL 11 DEVELOPMENT.
5. THE TEMPORARY STORMWATER COLLECTION SUMP AND ASSOCIATED DITCH SHOWN ALONG THE NORTHERN EDGE OF THE NEWLY CONSTRUCTED CELL REPRESENTS A TYPICAL INTERIM STORMWATER MANAGEMENT SYSTEM DURING CELL CONSTRUCTION. ACTUAL INTERIM STORMWATER MANAGEMENT STRUCTURES MAY DIFFER FROM WHAT IS SHOWN BASED ON OPERATIONAL NEEDS.
6. THE TEMPORARY TERRACE BENCH AND DRAINAGE DITCH SHOWN ALONG THE OPERATIONAL SLOPE OF THE LANDFILL REPRESENTS A TYPICAL INTERIM STORMWATER MANAGEMENT FEATURE. TEMPORARY TERRACE BENCHES MAY BE USED TO COLLECT STORMWATER FROM AREAS OF THE OPERATIONAL SLOPE WHERE INTERMEDIATE COVER HAS BEEN APPLIED. INTERIM STORMWATER MANAGEMENT STRUCTURES MAY DIFFER FROM WHAT IS SHOWN BASED ON OPERATIONAL NEEDS.
7. INTERIM STORMWATER MANAGEMENT STRUCTURES MAY BE MODIFIED TO ACCOMMODATE CONSTRUCTION ACTIVITIES AS THEY PROGRESS, AND SHOULD BE APPROPRIATELY SIZED TO MANAGE STORMWATER RUNOFF DURING CONSTRUCTION.
8. THE ANTICIPATED CONSTRUCTION PHASING DEPICTED IN THIS DRAWING IS SUBJECT TO CHANGE BASED ON OPERATIONAL NEEDS.

SECTION OR DETAIL LABEL
DRAWING ON WHICH SECTION OR DETAIL IS SHOWN

SECTIONS AND DETAIL KEY

REV. NO.	DATE	DESCRIPTION

GFL GREEN FOR LIFE environmental

APTIM Environmental & Infrastructure, LLC

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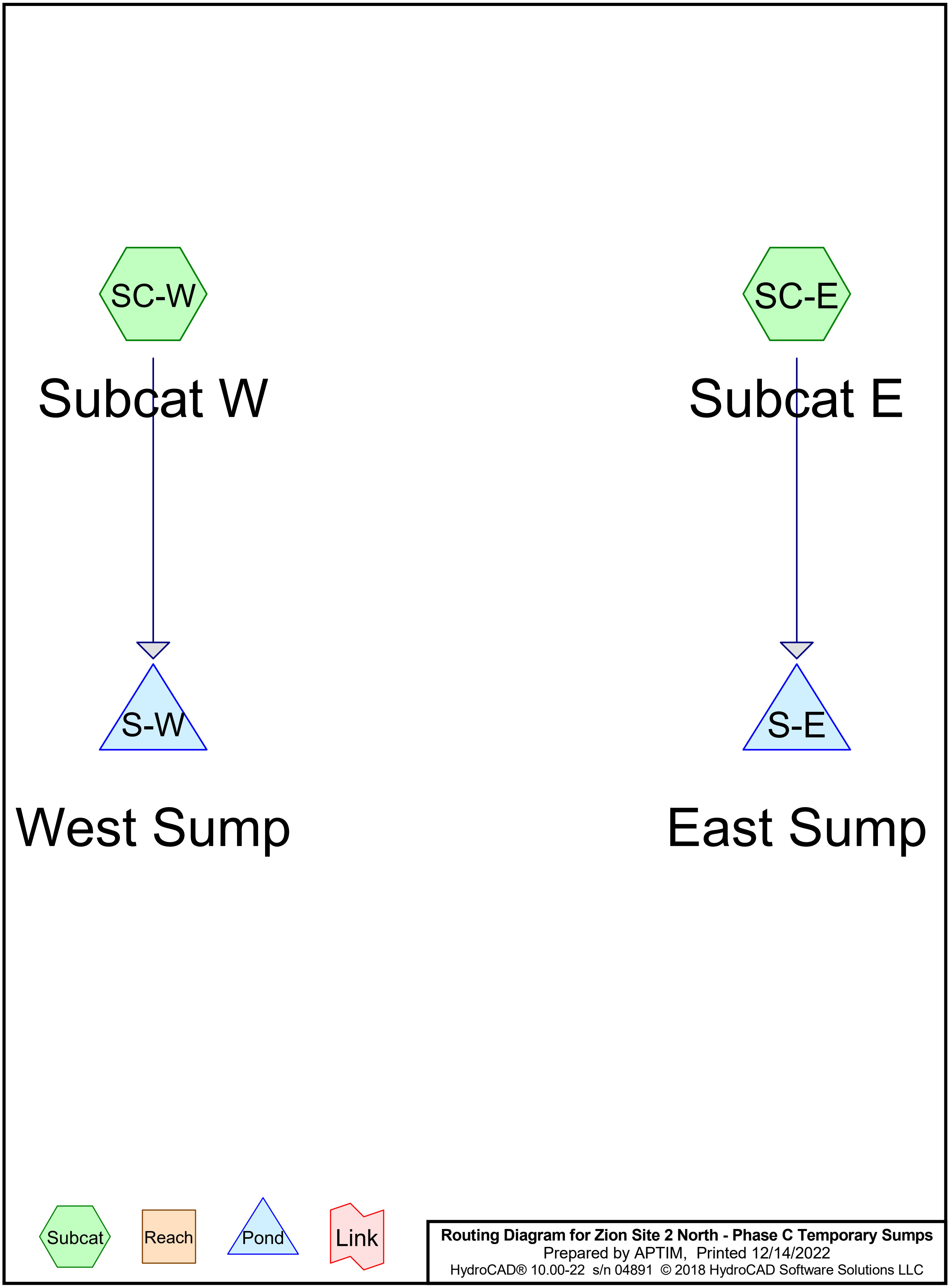
ZION LANDFILL - SITE 2 NORTH EXPANSION
CITY OF ZION, ILLINOIS

LANDFILL PHASING PLAN - PHASE C
TEMPORARY STORMWATER CONVEYANCE STRUCTURES
SUBCATCHMENT DELINEATION

PROJ. NO.:	631020105	DATE:	DECEMBER 2022
DESIGNED BY:	DAM/BWM/KM	DRAWING NO.	
DRAWN BY:	BWM/NV/KM		3
CHECKED BY:	DAM		
APPROVED BY:	DAM		3 OF 7 SHEETS



Routing Diagram for Zion Site 2 North - Phase C Temporary Sumps
Prepared by APTIM, Printed 12/14/2022
HydroCAD® 10.00-22 s/n 04891 © 2018 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
7.05	94	Newly graded area, HSG D (SC-E, SC-W)
7.05	**94**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.00	HSG A	
0.00	HSG B	
0.00	HSG C	
7.05	HSG D	SC-E, SC-W
0.00	Other	
7.05		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.00	0.00	0.00	7.05	0.00	7.05	Newly graded area	SC-E, SC-W
0.00	**0.00**	**0.00**	**7.05**	**0.00**	**7.05**	**TOTAL AREA**	

Time span=0.00-120.00 hrs, dt=0.05 hrs, 2401 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment SC-E: Subcat E Runoff Area=157,977 sf 0.00% Impervious Runoff Depth=5.74"
Tc=0.0 min CN=94 Runoff=2.14 cfs 1.736 af

Subcatchment SC-W: Subcat W Runoff Area=149,213 sf 0.00% Impervious Runoff Depth=5.74"
Tc=0.0 min CN=94 Runoff=2.02 cfs 1.639 af

Pond S-E: East Sump Peak Elev=697.79' Storage=75,596 cf Inflow=2.14 cfs 1.736 af
Outflow=0.00 cfs 0.000 af

Pond S-W: West Sump Peak Elev=691.61' Storage=71,403 cf Inflow=2.02 cfs 1.639 af
Outflow=0.00 cfs 0.000 af

Total Runoff Area = 7.05 ac Runoff Volume = 3.375 af Average Runoff Depth = 5.74"
100.00% Pervious = 7.05 ac 0.00% Impervious = 0.00 ac

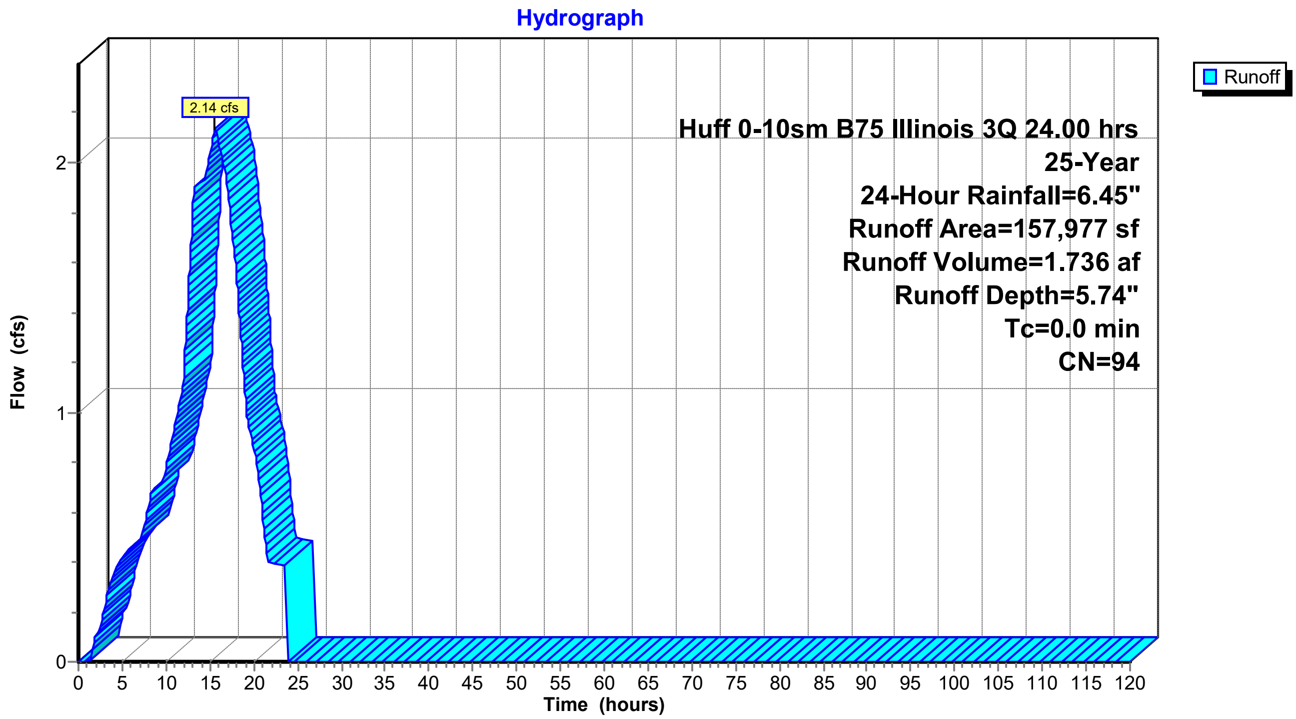
Summary for Subcatchment SC-E: Subcat E

Runoff = 2.14 cfs @ 15.60 hrs, Volume= 1.736 af, Depth= 5.74"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Huff 0-10sm B75 Illinois 3Q 24.00 hrs 25-Year, 24-Hour Rainfall=6.45"

Area (sf)	CN	Description
157,977	94	Newly graded area, HSG D
157,977		100.00% Pervious Area

Subcatchment SC-E: Subcat E



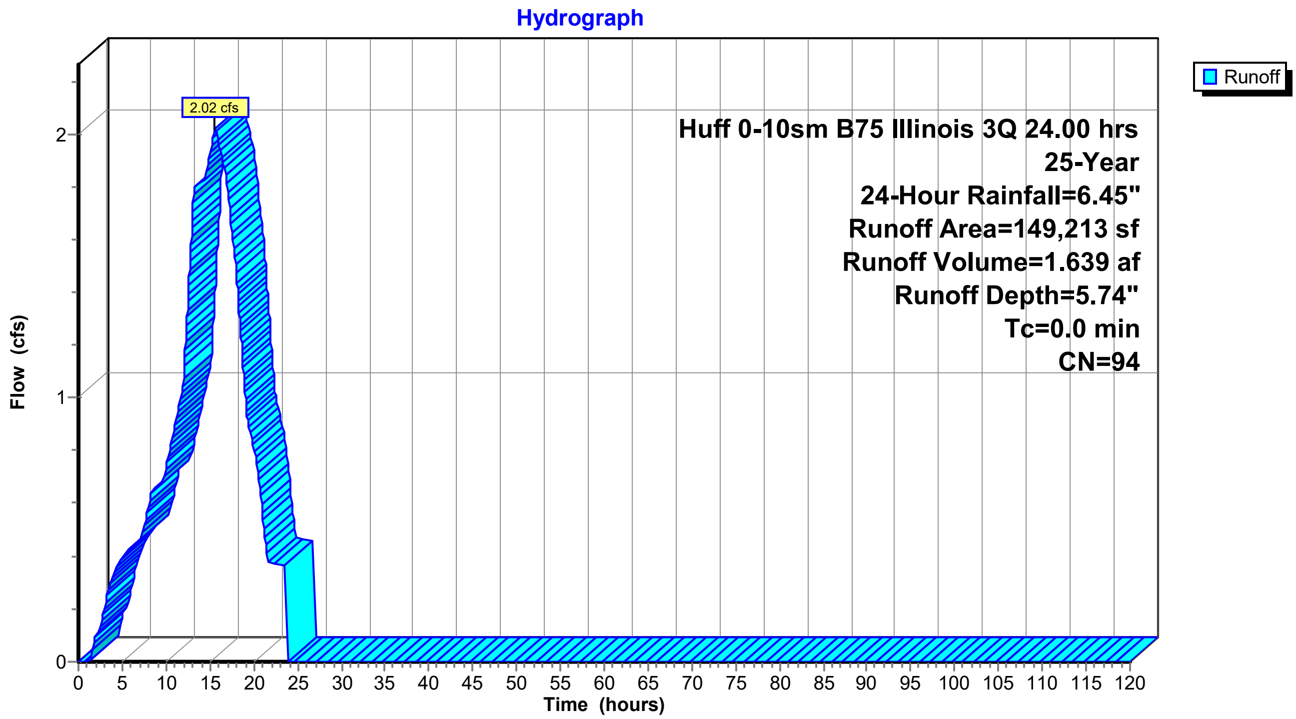
Summary for Subcatchment SC-W: Subcat W

Runoff = 2.02 cfs @ 15.60 hrs, Volume= 1.639 af, Depth= 5.74"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Huff 0-10sm B75 Illinois 3Q 24.00 hrs 25-Year, 24-Hour Rainfall=6.45"

Area (sf)	CN	Description
149,213	94	Newly graded area, HSG D
149,213		100.00% Pervious Area

Subcatchment SC-W: Subcat W



Summary for Pond S-E: East Sump

Inflow Area = 3.63 ac, 0.00% Impervious, Inflow Depth = 5.74" for 25-Year, 24-Hour event
Inflow = 2.14 cfs @ 15.60 hrs, Volume= 1.736 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min

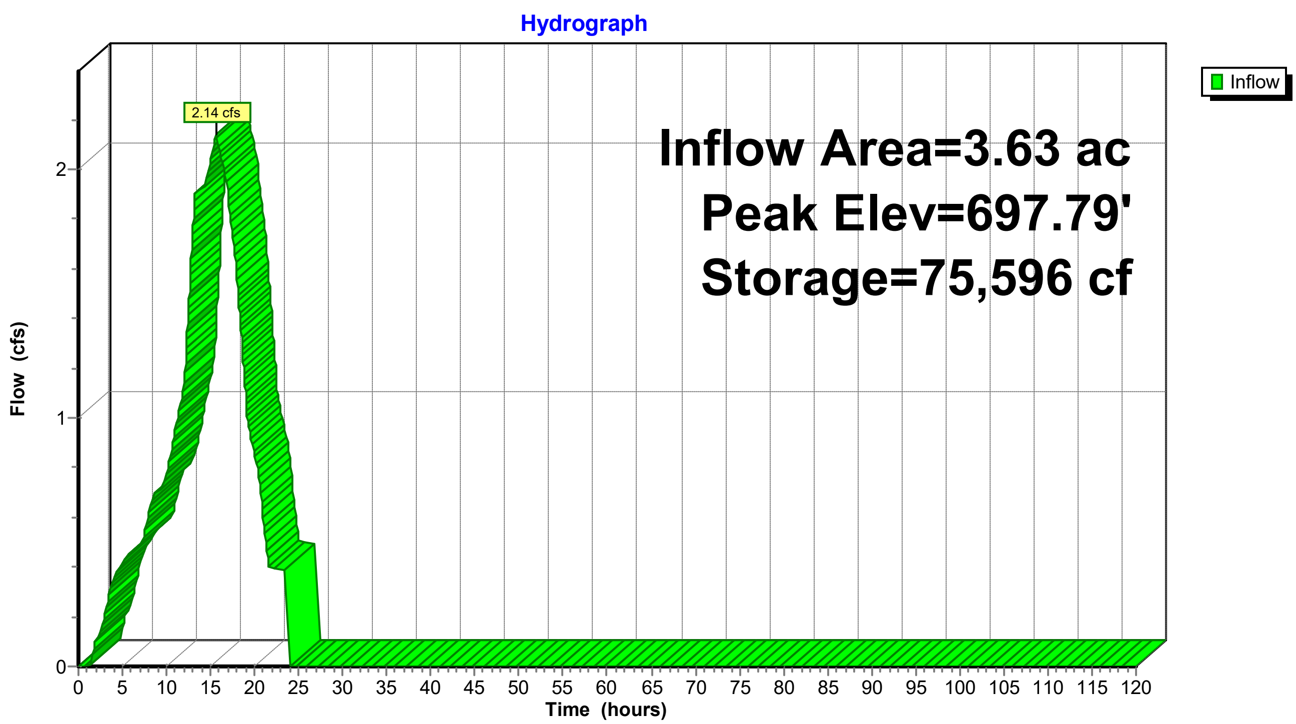
Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Peak Elev= 697.79' @ 24.05 hrs Surf.Area= 24,732 sf Storage= 75,596 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	690.00'	80,819 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
690.00	234	0	0
692.00	2,800	3,034	3,034
694.00	8,494	11,294	14,328
696.00	16,136	24,630	38,958
698.00	25,725	41,861	80,819

Pond S-E: East Sump



Summary for Pond S-W: West Sump

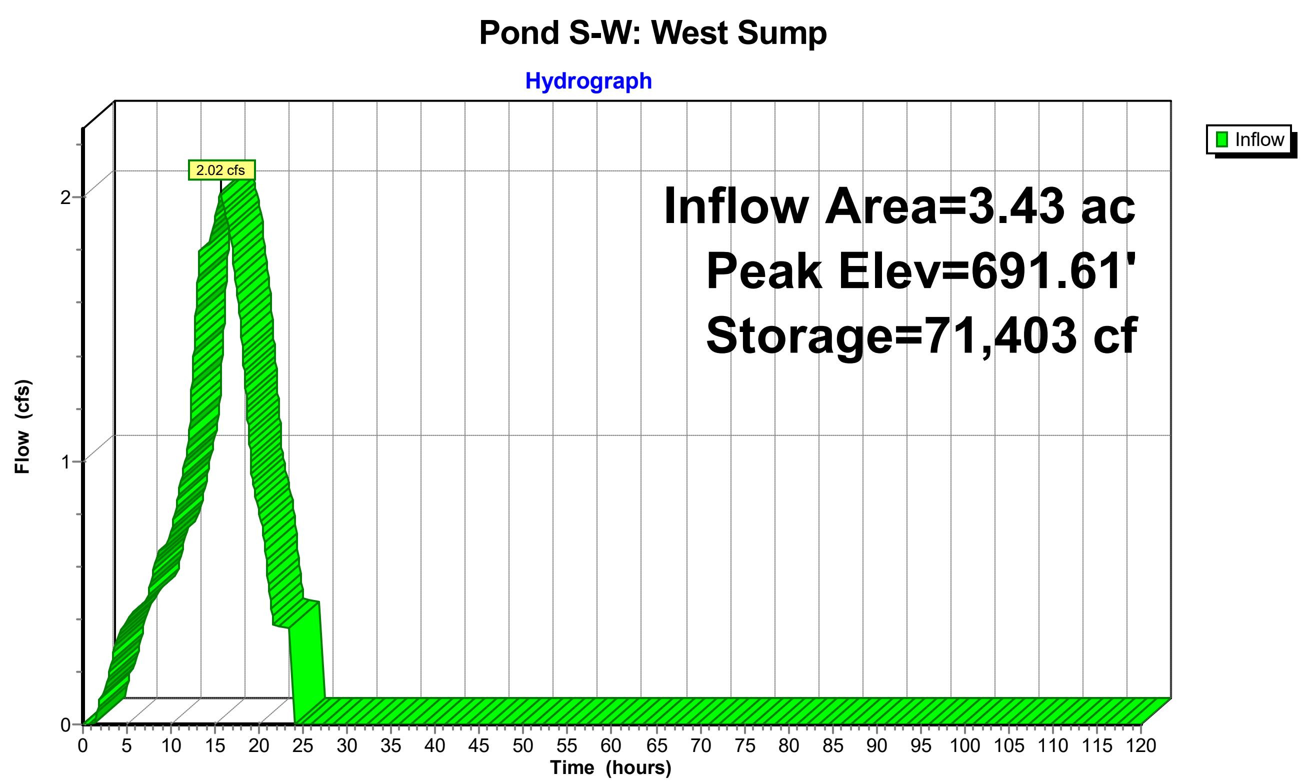
Inflow Area = 3.43 ac, 0.00% Impervious, Inflow Depth = 5.74" for 25-Year, 24-Hour event
Inflow = 2.02 cfs @ 15.60 hrs, Volume= 1.639 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min

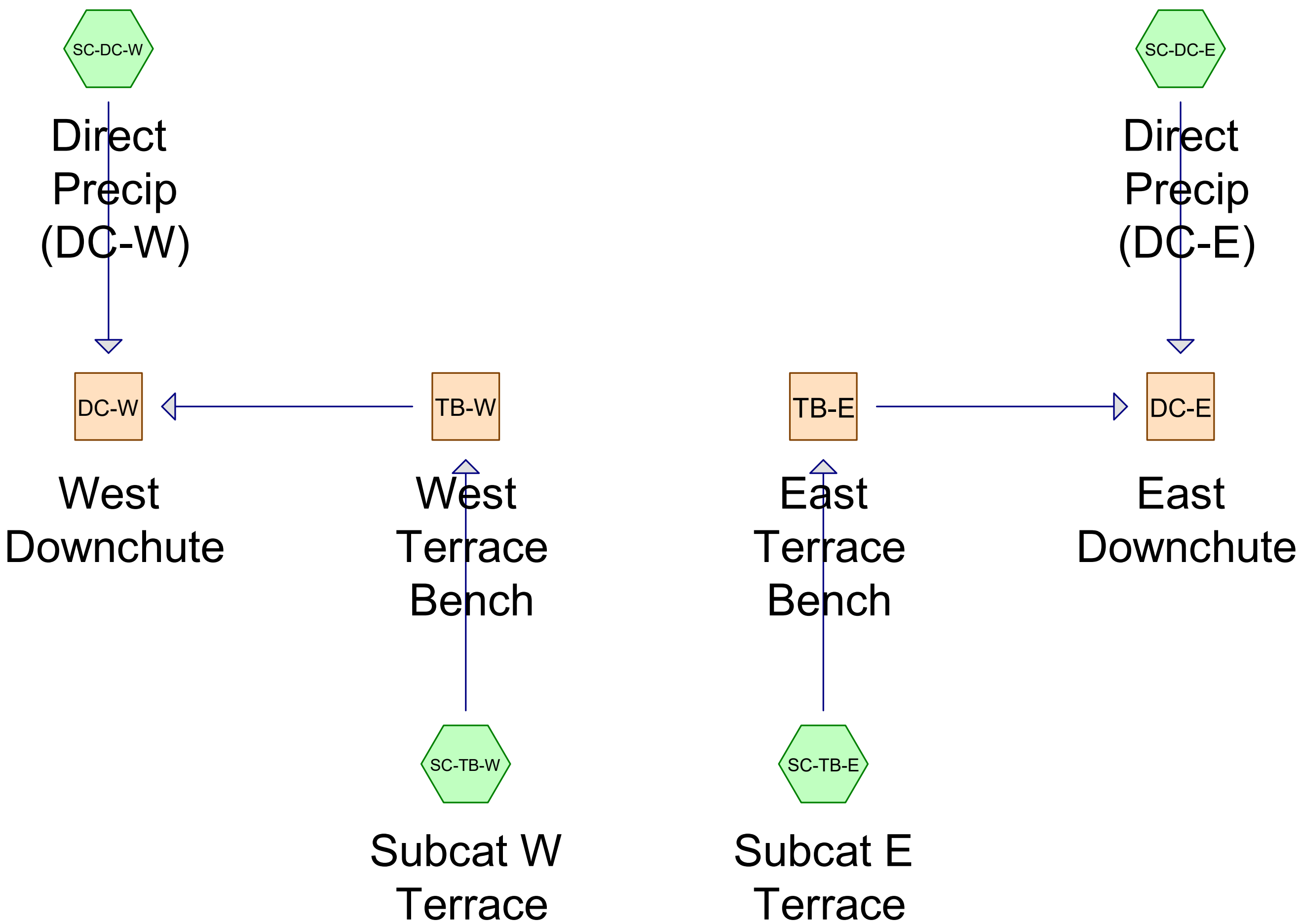
Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Peak Elev= 691.61' @ 24.05 hrs Surf.Area= 24,087 sf Storage= 71,403 cf

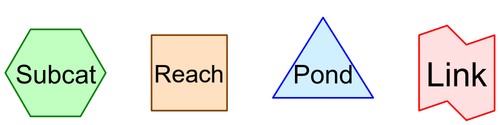
Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	684.00'	81,087 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
684.00	234	0	0
686.00	2,800	3,034	3,034
688.00	8,494	11,294	14,328
690.00	16,136	24,630	38,958
692.00	25,993	42,129	81,087







Routing Diagram for Zion Site 2 North - Phase C Temporary Terrace Benches and Downchutes
Prepared by APTIM, Printed 12/19/2022

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
6.71	94	Newly graded area, HSG D (SC-DC-E, SC-DC-W, SC-TB-E, SC-TB-W)
6.71	**94**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.00	HSG A	
0.00	HSG B	
0.00	HSG C	
6.71	HSG D	SC-DC-E, SC-DC-W, SC-TB-E, SC-TB-W
0.00	Other	
6.71		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.00	0.00	0.00	6.71	0.00	6.71	Newly graded area	SC-DC-E, SC-DC-W, SC-TB-E, SC-TB-W
0.00	**0.00**	**0.00**	**6.71**	**0.00**	**6.71**	**TOTAL AREA**	

Time span=0.00-120.00 hrs, dt=0.05 hrs, 2401 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment SC-DC-E: Direct Precip (DC-E) Runoff Area=624 sf 0.00% Impervious Runoff Depth=5.74"
Tc=0.0 min CN=94 Runoff=0.01 cfs 0.007 af

Subcatchment SC-DC-W: Direct Precip (DC-W) Runoff Area=624 sf 0.00% Impervious Runoff Depth=5.74"
Tc=0.0 min CN=94 Runoff=0.01 cfs 0.007 af

Subcatchment SC-TB-E: Subcat E Terrace Runoff Area=149,613 sf 0.00% Impervious Runoff Depth=5.74"
Flow Length=404' Slope=0.3333 '/' Tc=1.9 min CN=94 Runoff=2.02 cfs 1.644 af

Subcatchment SC-TB-W: Subcat W Terrace Runoff Area=141,557 sf 0.00% Impervious Runoff Depth=5.74"
Flow Length=404' Slope=0.3333 '/' Tc=1.9 min CN=94 Runoff=1.91 cfs 1.555 af

Reach DC-E: East Downchute Avg. Flow Depth=0.05' Max Vel=4.75 fps Inflow=2.03 cfs 1.650 af
n=0.022 L=54.0' S=0.2593 '/' Capacity=92.42 cfs Outflow=2.03 cfs 1.650 af

Reach DC-W: West Downchute Avg. Flow Depth=0.05' Max Vel=4.65 fps Inflow=1.92 cfs 1.562 af
n=0.022 L=54.0' S=0.2593 '/' Capacity=92.42 cfs Outflow=1.92 cfs 1.562 af

Reach TB-E: East Terrace Bench Avg. Flow Depth=0.41' Max Vel=1.86 fps Inflow=2.02 cfs 1.644 af
n=0.022 L=620.0' S=0.0065 '/' Capacity=253.01 cfs Outflow=2.02 cfs 1.644 af

Reach TB-W: West Terrace Bench Avg. Flow Depth=0.38' Max Vel=2.02 fps Inflow=1.91 cfs 1.555 af
n=0.022 L=482.0' S=0.0083 '/' Capacity=286.96 cfs Outflow=1.91 cfs 1.555 af

Total Runoff Area = 6.71 ac Runoff Volume = 3.212 af Average Runoff Depth = 5.74"
100.00% Pervious = 6.71 ac 0.00% Impervious = 0.00 ac

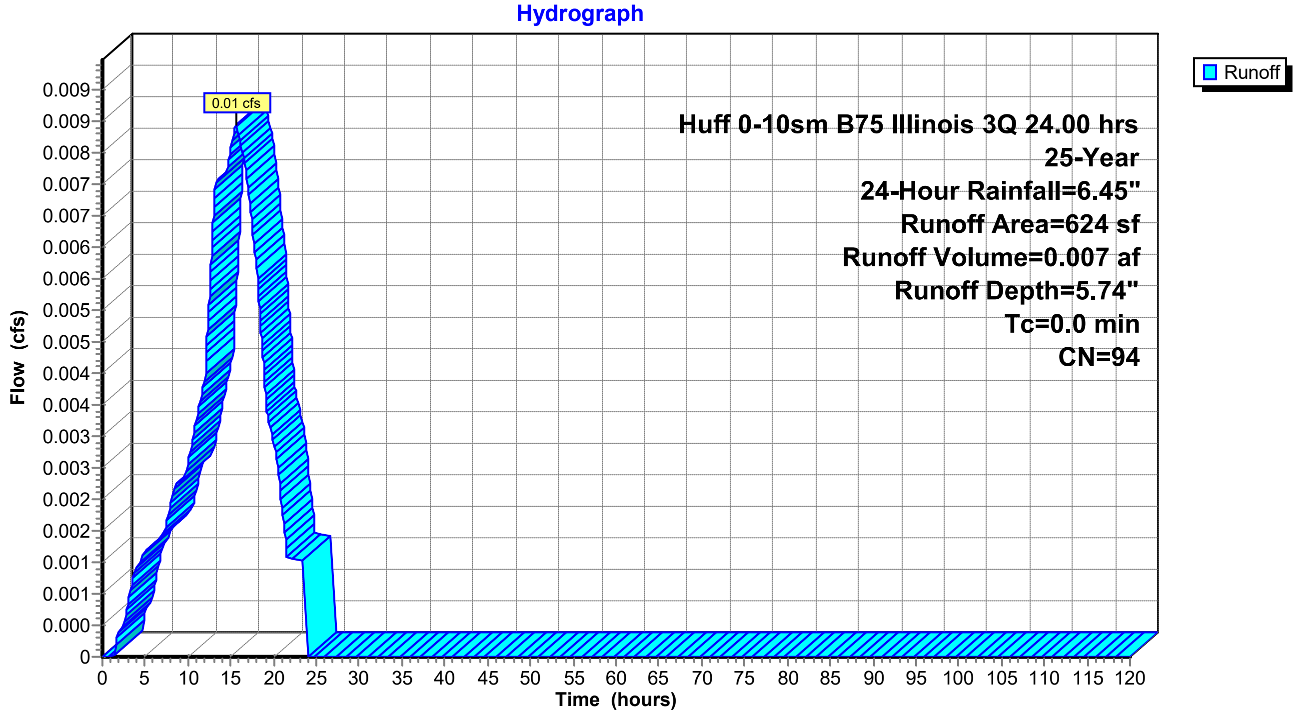
Summary for Subcatchment SC-DC-E: Direct Precip (DC-E)

Runoff = 0.01 cfs @ 15.60 hrs, Volume= 0.007 af, Depth= 5.74"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Huff 0-10sm B75 Illinois 3Q 24.00 hrs 25-Year, 24-Hour Rainfall=6.45"

Area (sf)	CN	Description
624	94	Newly graded area, HSG D
624		100.00% Pervious Area

Subcatchment SC-DC-E: Direct Precip (DC-E)



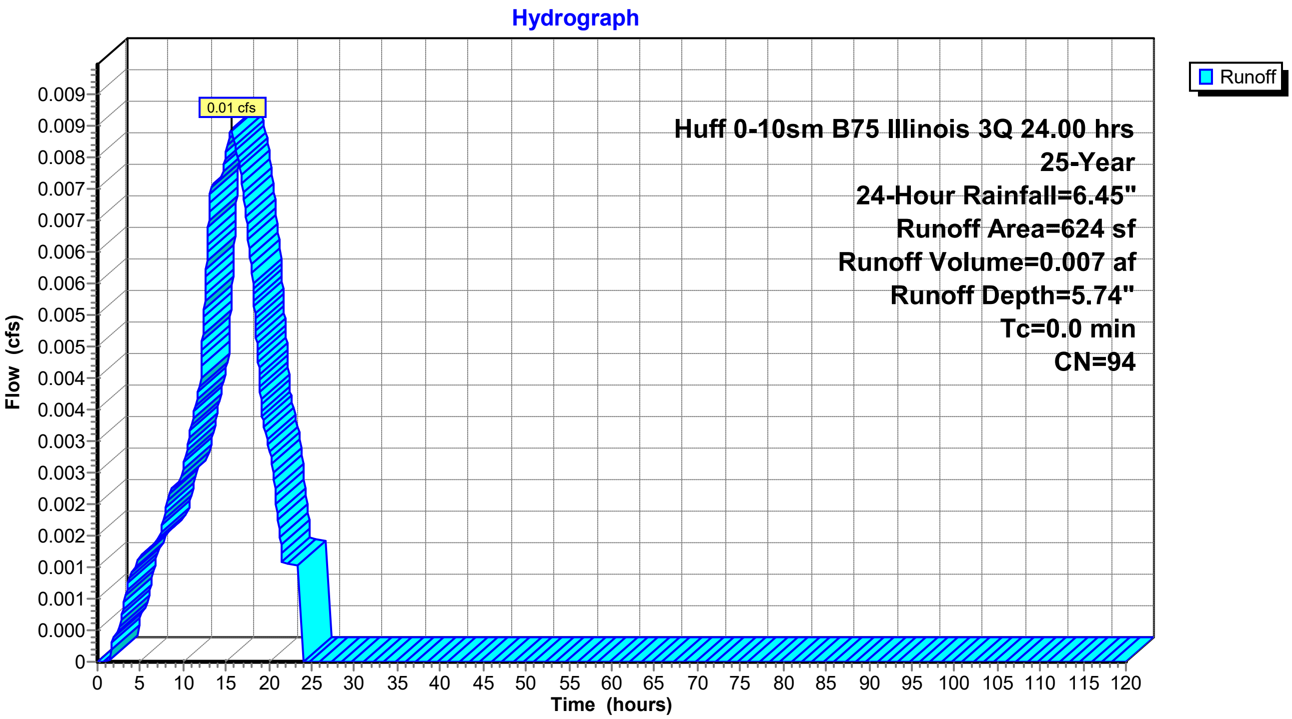
Summary for Subcatchment SC-DC-W: Direct Precip (DC-W)

Runoff = 0.01 cfs @ 15.60 hrs, Volume= 0.007 af, Depth= 5.74"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Huff 0-10sm B75 Illinois 3Q 24.00 hrs 25-Year, 24-Hour Rainfall=6.45"

Area (sf)	CN	Description
624	94	Newly graded area, HSG D
624		100.00% Pervious Area

Subcatchment SC-DC-W: Direct Precip (DC-W)



Summary for Subcatchment SC-TB-E: Subcat E Terrace

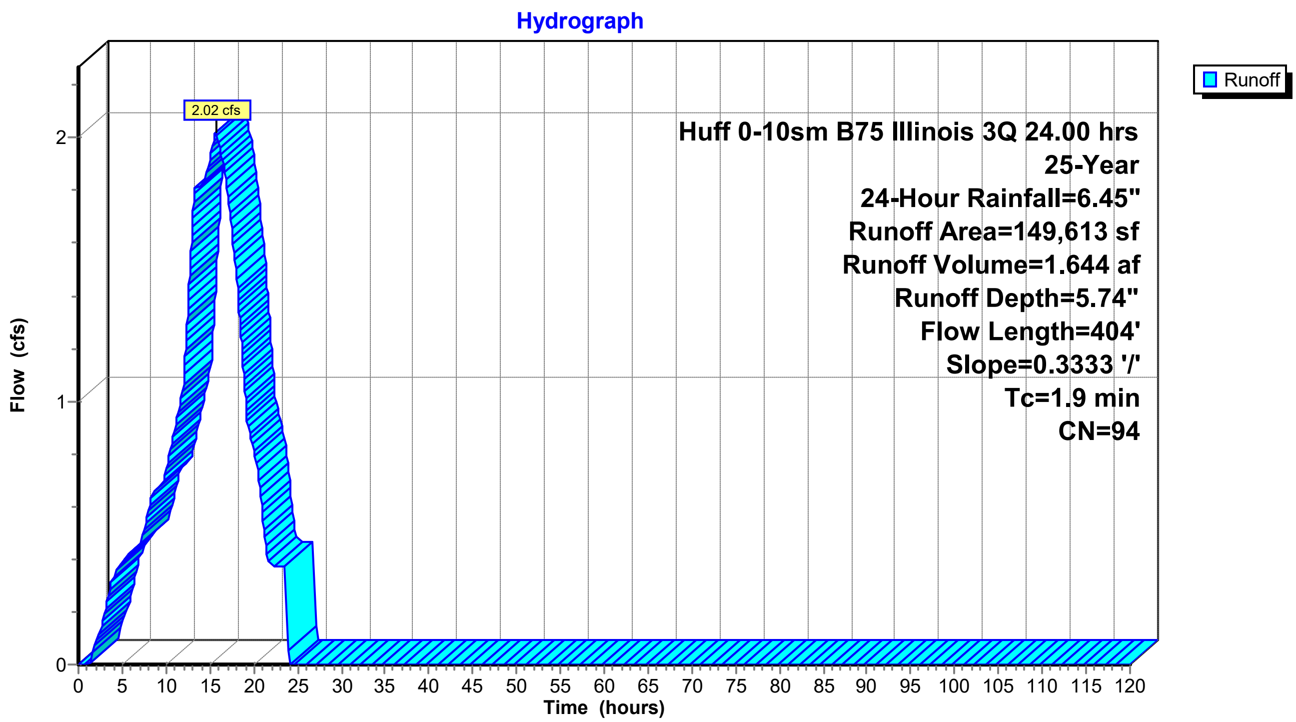
Runoff = 2.02 cfs @ 15.63 hrs, Volume= 1.644 af, Depth= 5.74"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Huff 0-10sm B75 Illinois 3Q 24.00 hrs 25-Year, 24-Hour Rainfall=6.45"

Area (sf)	CN	Description
149,613	94	Newly graded area, HSG D
149,613		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.4	100	0.3333	1.18		**Sheet Flow,** Fallow n= 0.050 P2= 2.80"
0.5	304	0.3333	9.29		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
1.9	404	Total			

Subcatchment SC-TB-E: Subcat E Terrace



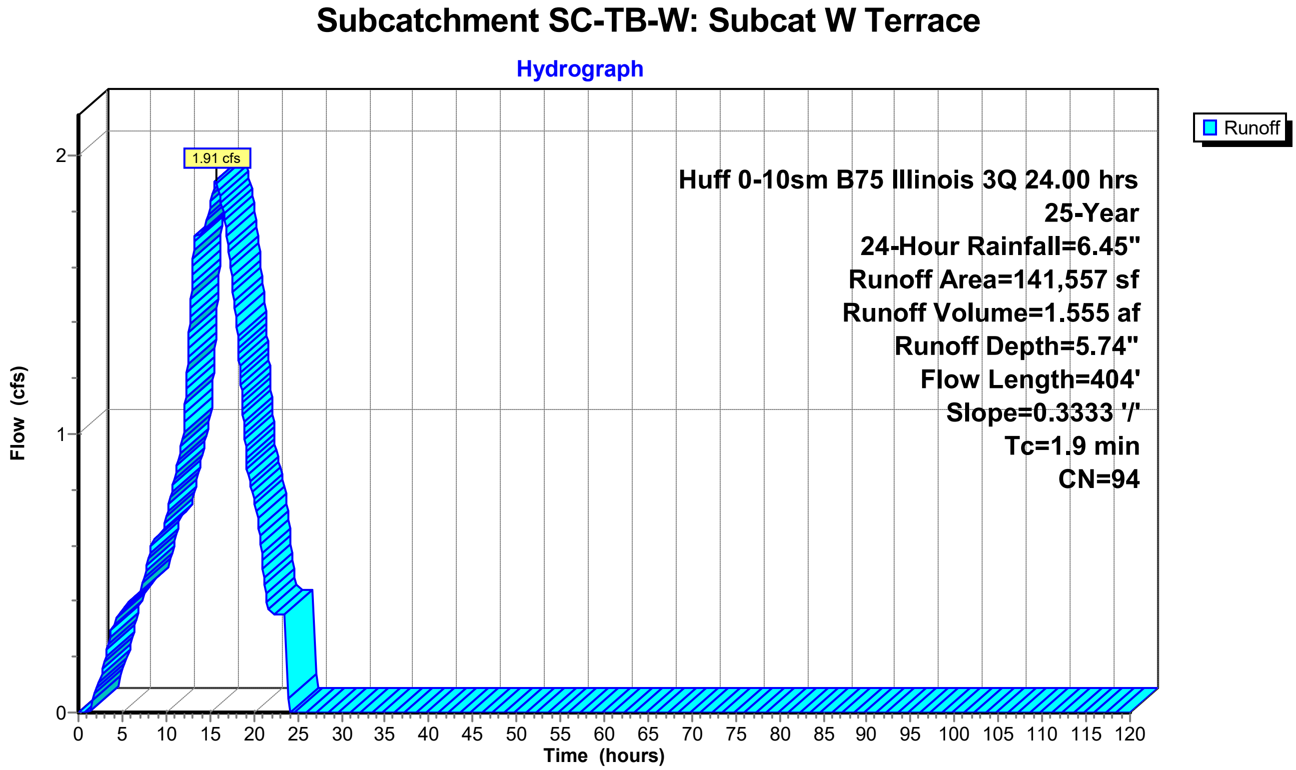
Summary for Subcatchment SC-TB-W: Subcat W Terrace

Runoff = 1.91 cfs @ 15.63 hrs, Volume= 1.555 af, Depth= 5.74"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Huff 0-10sm B75 Illinois 3Q 24.00 hrs 25-Year, 24-Hour Rainfall=6.45"

Area (sf)	CN	Description
141,557	94	Newly graded area, HSG D
141,557		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.4	100	0.3333	1.18		**Sheet Flow,** Fallow n= 0.050 P2= 2.80"
0.5	304	0.3333	9.29		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
1.9	404	Total			



Summary for Reach DC-E: East Downchute

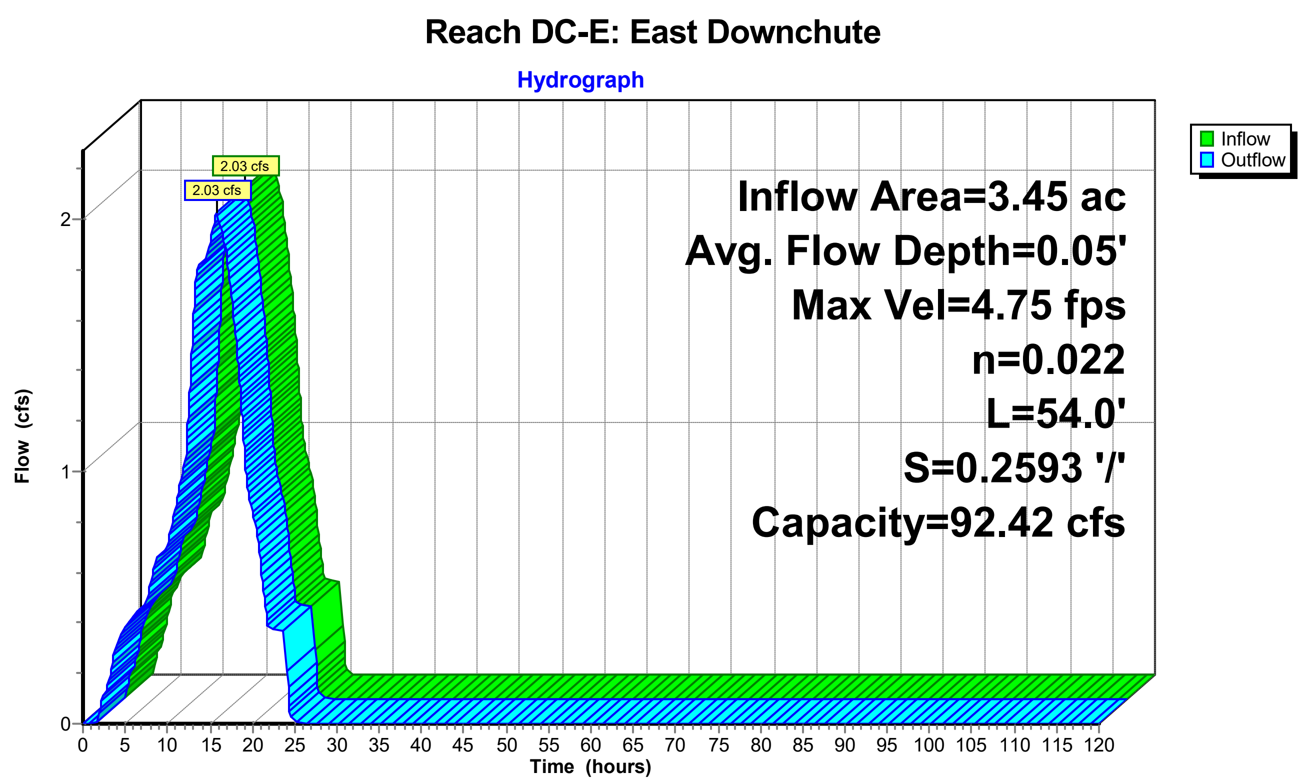
Inflow Area = 3.45 ac, 0.00% Impervious, Inflow Depth = 5.74" for 25-Year, 24-Hour event
Inflow = 2.03 cfs @ 15.79 hrs, Volume= 1.650 af
Outflow = 2.03 cfs @ 15.79 hrs, Volume= 1.650 af, Atten= 0%, Lag= 0.3 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.75 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 2.98 fps, Avg. Travel Time= 0.3 min

Peak Storage= 23 cf @ 15.79 hrs
Average Depth at Peak Storage= 0.05'
Bank-Full Depth= 0.50' Flow Area= 4.8 sf, Capacity= 92.42 cfs

8.00' x 0.50' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 3.0 '/' Top Width= 11.00'
Length= 54.0' Slope= 0.2593 '/'
Inlet Invert= 764.00', Outlet Invert= 750.00'

‡



Summary for Reach DC-W: West Downchute

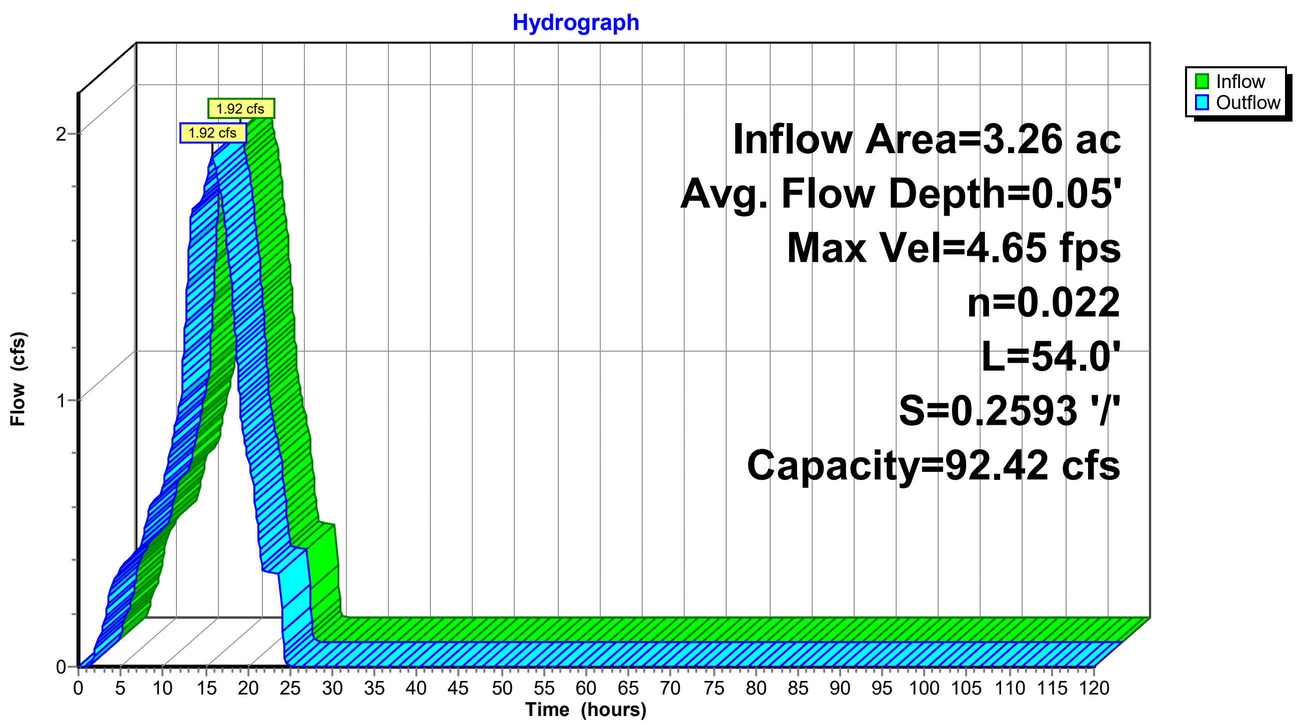
Inflow Area = 3.26 ac, 0.00% Impervious, Inflow Depth = 5.74" for 25-Year, 24-Hour event
Inflow = 1.92 cfs @ 15.74 hrs, Volume= 1.562 af
Outflow = 1.92 cfs @ 15.75 hrs, Volume= 1.562 af, Atten= 0%, Lag= 0.3 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.65 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 2.99 fps, Avg. Travel Time= 0.3 min

Peak Storage= 22 cf @ 15.75 hrs
Average Depth at Peak Storage= 0.05'
Bank-Full Depth= 0.50' Flow Area= 4.8 sf, Capacity= 92.42 cfs

8.00' x 0.50' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 3.0 '/' Top Width= 11.00'
Length= 54.0' Slope= 0.2593 '/'
Inlet Invert= 764.00', Outlet Invert= 750.00'

Reach DC-W: West Downchute



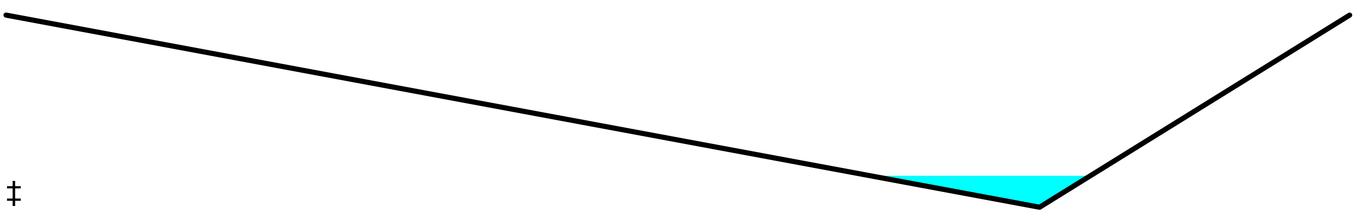
Summary for Reach TB-E: East Terrace Bench

Inflow Area = 3.43 ac, 0.00% Impervious, Inflow Depth = 5.74" for 25-Year, 24-Hour event
Inflow = 2.02 cfs @ 15.63 hrs, Volume= 1.644 af
Outflow = 2.02 cfs @ 15.79 hrs, Volume= 1.644 af, Atten= 0%, Lag= 9.1 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.86 fps, Min. Travel Time= 5.5 min
Avg. Velocity = 1.29 fps, Avg. Travel Time= 8.0 min

Peak Storage= 672 cf @ 15.69 hrs
Average Depth at Peak Storage= 0.41'
Bank-Full Depth= 2.50' Flow Area= 40.6 sf, Capacity= 253.01 cfs

0.00' x 2.50' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 10.0 3.0 '/' Top Width= 32.50'
Length= 620.0' Slope= 0.0065 '/'
Inlet Invert= 768.00', Outlet Invert= 764.00'



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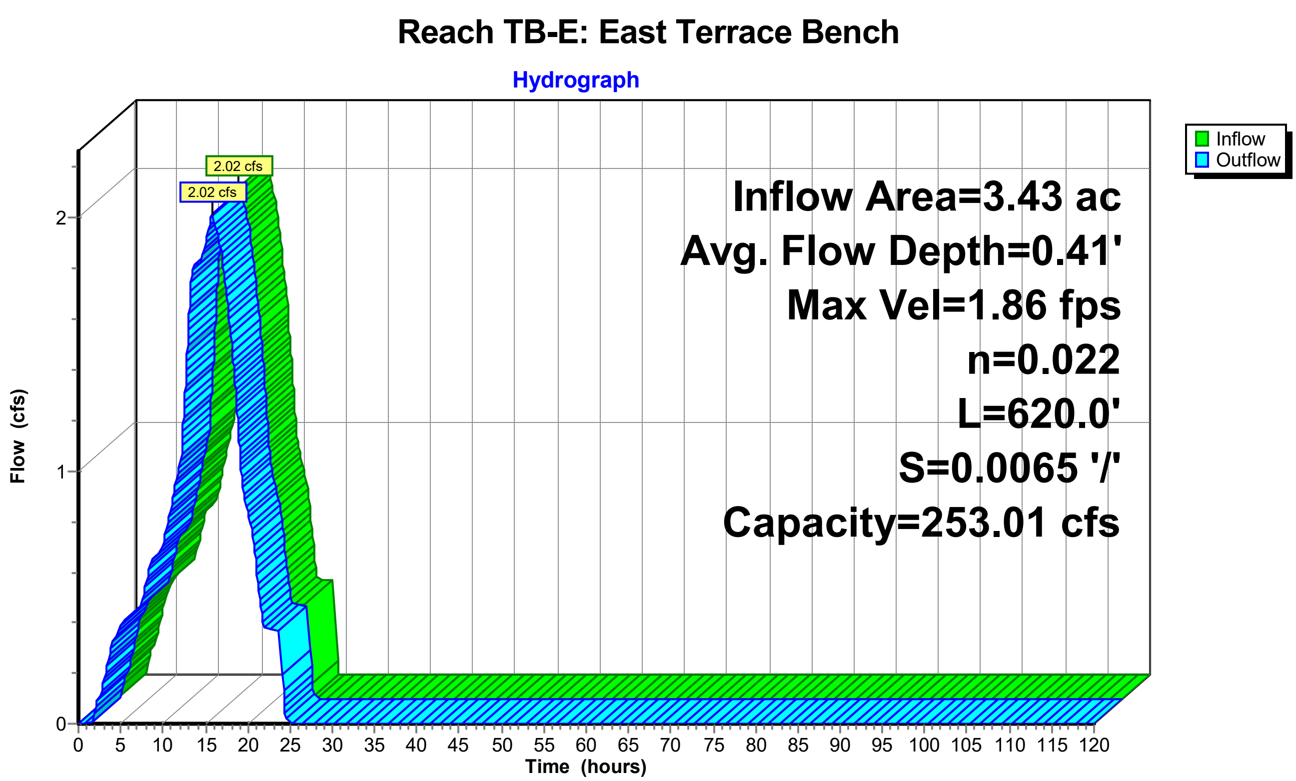


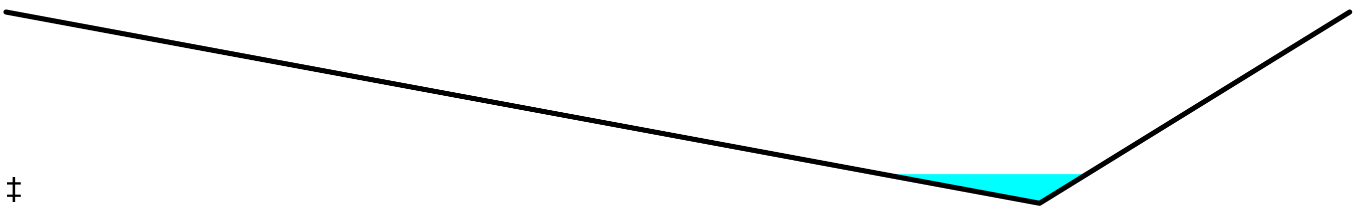
Summary for Reach TB-W: West Terrace Bench

Inflow Area = 3.25 ac, 0.00% Impervious, Inflow Depth = 5.74" for 25-Year, 24-Hour event
Inflow = 1.91 cfs @ 15.63 hrs, Volume= 1.555 af
Outflow = 1.91 cfs @ 15.75 hrs, Volume= 1.555 af, Atten= 0%, Lag= 6.7 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.02 fps, Min. Travel Time= 4.0 min
Avg. Velocity = 1.45 fps, Avg. Travel Time= 5.5 min

Peak Storage= 456 cf @ 15.68 hrs
Average Depth at Peak Storage= 0.38'
Bank-Full Depth= 2.50' Flow Area= 40.6 sf, Capacity= 286.96 cfs

0.00' x 2.50' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 10.0 3.0 '/' Top Width= 32.50'
Length= 482.0' Slope= 0.0083 '/'
Inlet Invert= 768.00', Outlet Invert= 764.00'



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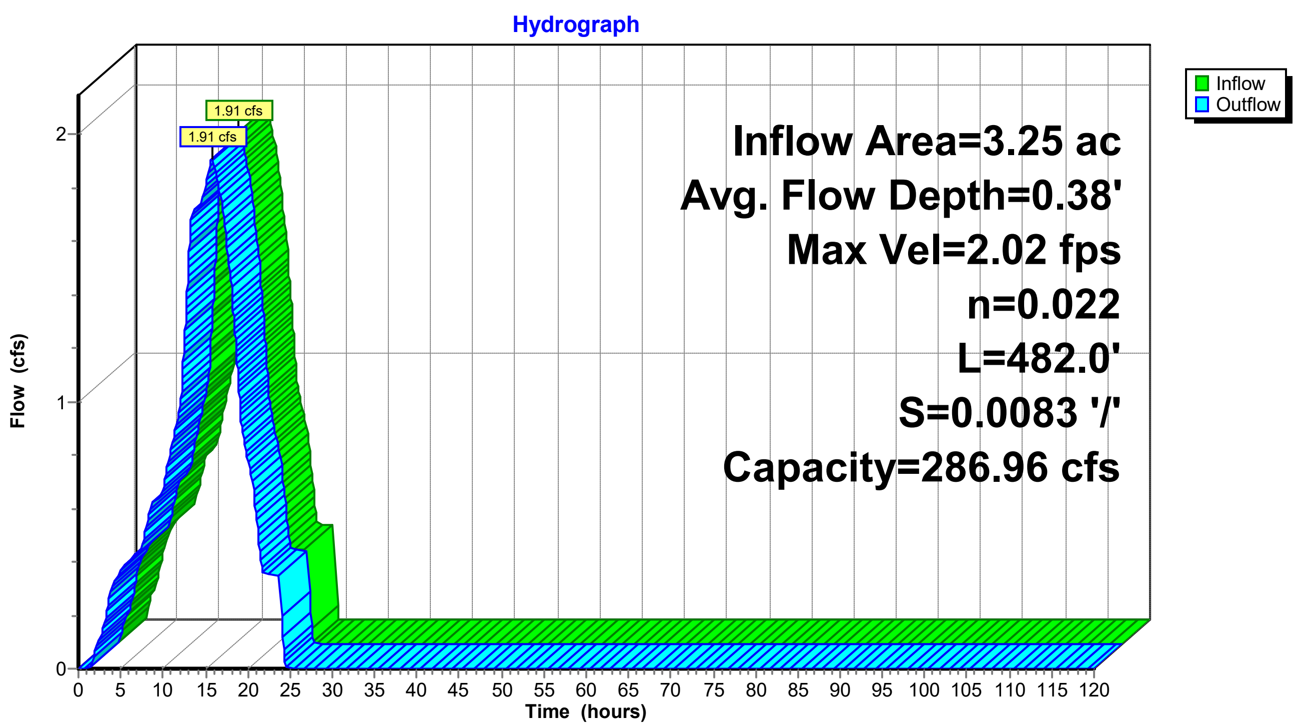
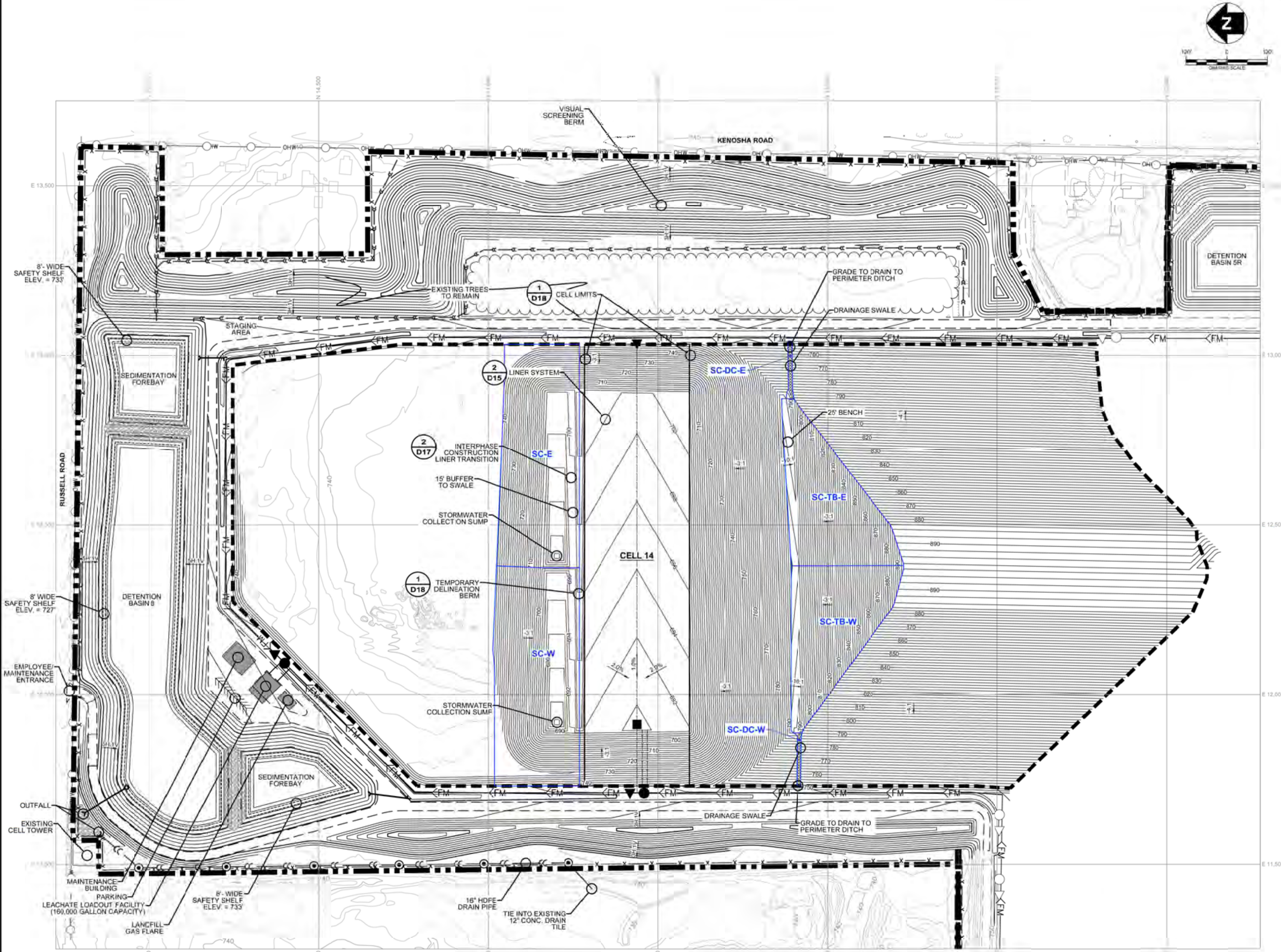
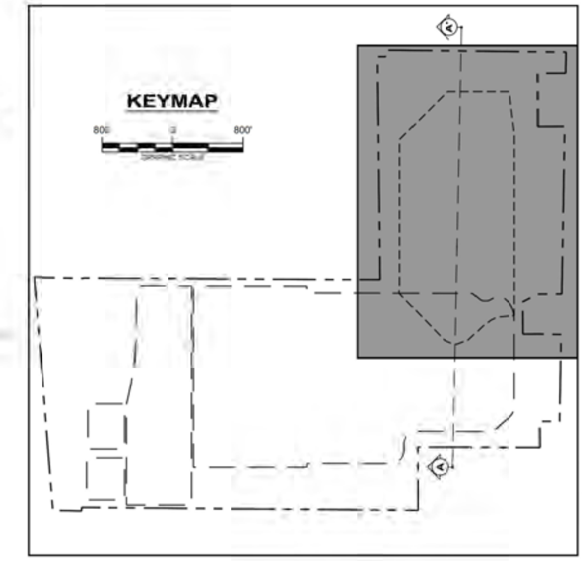
Reach TB-W: West Terrace Bench



Phase D
25-year, 24-hour HydroCAD Outputs





LEGEND

- APPROXIMATE FACILITY BOUNDARY
- APPROXIMATE EXISTING WASTE BOUNDARY
- APPROXIMATE PROPOSED EXPANSION WASTE BOUNDARY
- EXISTING CONTOUR
- EXISTING ROAD
- EXISTING VEGETATION
- EXISTING FENCE
- EXISTING CULVERT
- PROPOSED GROUND SURFACE ELEVATION CONTOUR (FEET-MSL)
- PROPOSED ROAD
- PROPOSED CULVERT
- EXISTING FORCEMAIN
- EXISTING LEACHATE COLLECTION PIPE
- EXISTING LEACHATE CLEANOUT LOCATION
- EXISTING LEACHATE VAULT LOCATION
- EXISTING LEACHATE COLLECTION SUMP LOCATION
- PROPOSED FORCEMAIN
- PROPOSED LEACHATE COLLECTION PIPE
- PROPOSED LEACHATE CLEANOUT LOCATION
- PROPOSED LEACHATE VAULT/MANHOLE LOCATION
- PROPOSED LEACHATE COLLECTION SUMP LOCATION
- PROPOSED DRAIN TILE
- STORMWATER MANHOLE
- STORMWATER HEADWALL
- SUBCATCHMENT BOUNDARY

NOTES

1. EXISTING CONTOURS DEVELOPED FROM SITE AERIAL TOPOGRAPHIC SURVEY BY CQM, INC. ON 10/22/2018 EXCEPT STORMWATER MANAGEMENT FEATURES ASSOCIATED WITH SITE 2 EAST (DITCHES AND BASIN 5R). STORMWATER DESIGN GRADES ARE SHOWN FOR THESE FEATURES FOR COMPLETENESS, AS NOT ALL GRADES ARE CAPTURED BY THE TOPOGRAPHIC SURVEY.
2. CURRENT TOPOGRAPHY MAY DIFFER FROM THAT SHOWN.
3. FOR CLARITY, NOT ALL SITE FEATURES MAY BE SHOWN.
4. CELL DEVELOPMENT WILL PROCEED IN NUMERICAL ORDER. VERTICAL EXPANSION WILL PROGRESS CONCURRENT WITH CELL 11 DEVELOPMENT.
5. THE TEMPORARY STORMWATER COLLECTION SUMP AND ASSOCIATED DITCH SHOWN ALONG THE NORTHERN EDGE OF THE NEWLY CONSTRUCTED CELL REPRESENTS A TYPICAL INTERIM STORMWATER MANAGEMENT SYSTEM DURING CELL CONSTRUCTION. ACTUAL INTERIM STORMWATER MANAGEMENT STRUCTURES MAY DIFFER FROM WHAT IS SHOWN BASED ON OPERATIONAL NEEDS.
6. THE TEMPORARY TERRACE BENCH AND DRAINAGE DITCH SHOWN ALONG THE OPERATIONAL SLOPE OF THE LANDFILL REPRESENTS A TYPICAL INTERIM STORMWATER MANAGEMENT FEATURE. TEMPORARY TERRACE BENCHES MAY BE USED TO COLLECT STORMWATER FROM AREAS OF THE OPERATIONAL SLOPE WHERE INTERMEDIATE COVER HAS BEEN APPLIED. INTERIM STORMWATER MANAGEMENT STRUCTURES MAY DIFFER FROM WHAT IS SHOWN BASED ON OPERATIONAL NEEDS.
7. INTERIM STORMWATER MANAGEMENT STRUCTURES MAY BE MODIFIED TO ACCOMMODATE CONSTRUCTION ACTIVITIES AS THEY PROGRESS, AND SHOULD BE APPROPRIATELY SIZED TO MANAGE STORMWATER RUNOFF DURING CONSTRUCTION.
8. THE ANTICIPATED CONSTRUCTION PHASING DEPICTED IN THIS DRAWING IS SUBJECT TO CHANGE BASED ON OPERATIONAL NEEDS.

SECTION OR DETAIL LABEL
DRAWING ON WHICH SECTION OR DETAIL IS SHOWN

SECTIONS AND DETAIL KEY

REV. NO.	DATE	DESCRIPTION

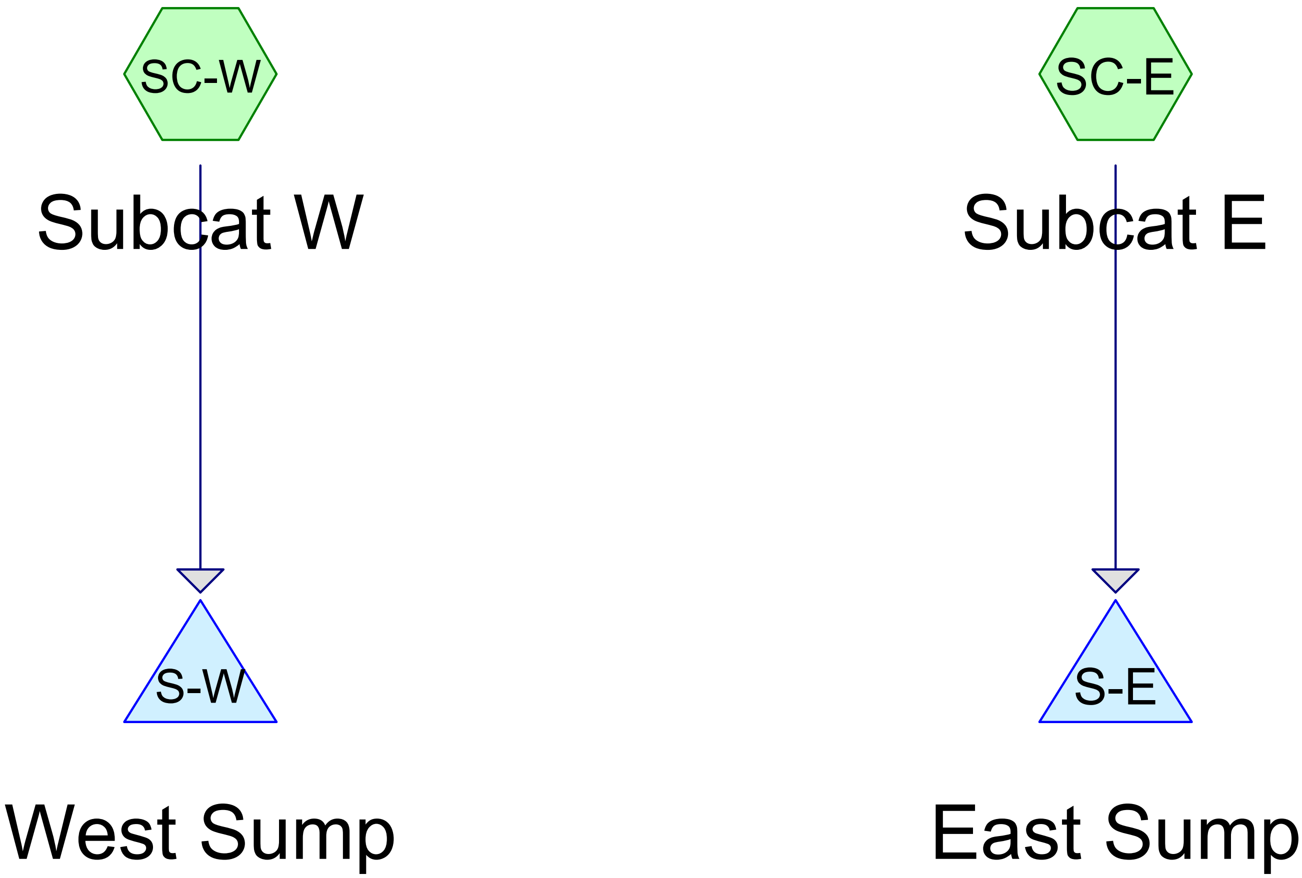
GFL GREEN FOR LIFE environmental

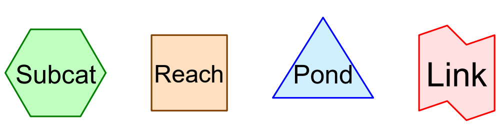
APTIM Environmental & Infrastructure, LLC

ZION LANDFILL - SITE 2 NORTH EXPANSION
CITY OF ZION, ILLINOIS

LANDFILL PHASING PLAN - PHASE D
TEMPORARY STORMWATER CONVEYANCE STRUCTURES
SUBCATCHMENT DELINEATION

PROJ. NO.	631020105	DATE:	DECEMBER 2022
DESIGNED BY:	DAM/BWM/KM	DRAWING NO.	
DRAWN BY:	BWM/NV/KM		4
CHECKED BY:	DAM		
APPROVED BY:	DAM		4 OF 7 SHEETS





Routing Diagram for Zion Site 2 North - Phase D Temporary Sumps
Prepared by APTIM, Printed 12/14/2022

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
7.19	94	Newly graded area, HSG D (SC-E, SC-W)
7.19	**94**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.00	HSG A	
0.00	HSG B	
0.00	HSG C	
7.19	HSG D	SC-E, SC-W
0.00	Other	
7.19		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.00	0.00	0.00	7.19	0.00	7.19	Newly graded area	SC-E, SC-W
0.00	**0.00**	**0.00**	**7.19**	**0.00**	**7.19**	**TOTAL AREA**	

Time span=0.00-120.00 hrs, dt=0.05 hrs, 2401 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment SC-E: Subcat E Runoff Area=151,829 sf 0.00% Impervious Runoff Depth=5.74"
Tc=0.0 min CN=94 Runoff=2.06 cfs 1.668 af

Subcatchment SC-W: Subcat W Runoff Area=161,436 sf 0.00% Impervious Runoff Depth=5.74"
Tc=0.0 min CN=94 Runoff=2.19 cfs 1.774 af

Pond S-E: East Sump Peak Elev=697.67' Storage=72,656 cf Inflow=2.06 cfs 1.668 af
Outflow=0.00 cfs 0.000 af

Pond S-W: West Sump Peak Elev=691.85' Storage=77,253 cf Inflow=2.19 cfs 1.774 af
Outflow=0.00 cfs 0.000 af

Total Runoff Area = 7.19 ac Runoff Volume = 3.442 af Average Runoff Depth = 5.74"
100.00% Pervious = 7.19 ac 0.00% Impervious = 0.00 ac

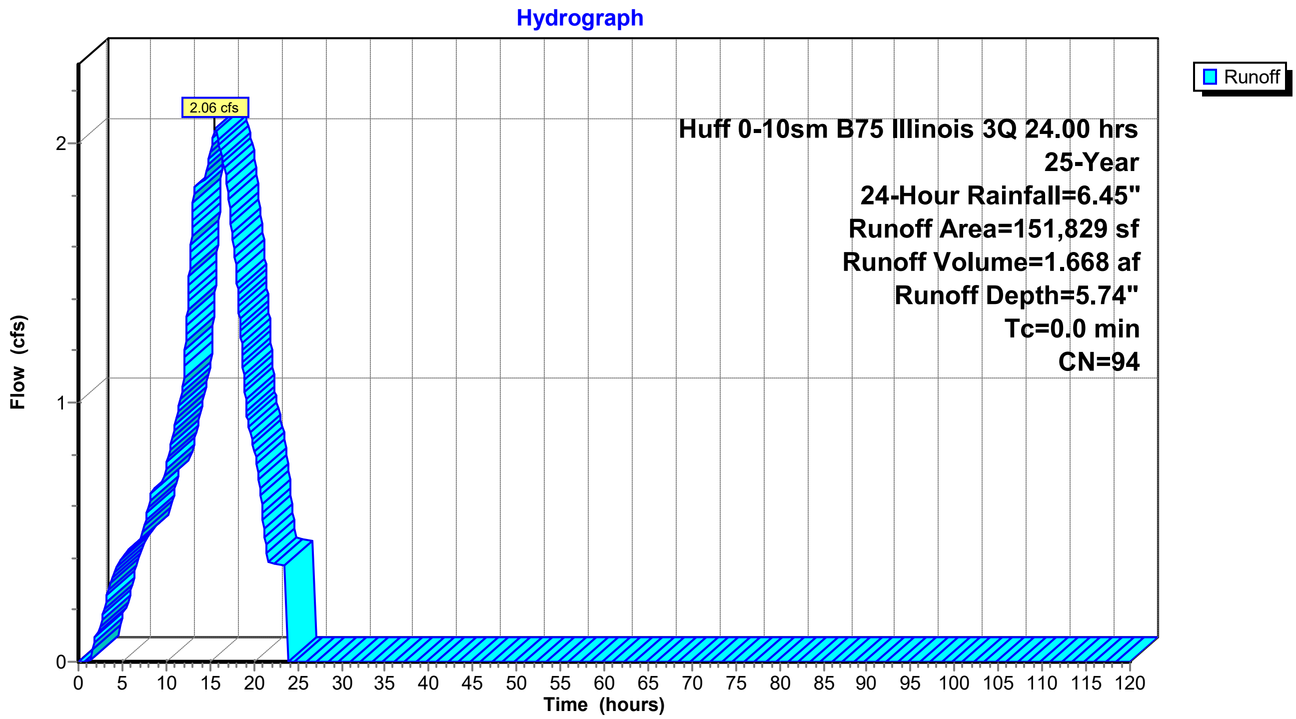
Summary for Subcatchment SC-E: Subcat E

Runoff = 2.06 cfs @ 15.60 hrs, Volume= 1.668 af, Depth= 5.74"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Huff 0-10sm B75 Illinois 3Q 24.00 hrs 25-Year, 24-Hour Rainfall=6.45"

Area (sf)	CN	Description
151,829	94	Newly graded area, HSG D
151,829		100.00% Pervious Area

Subcatchment SC-E: Subcat E



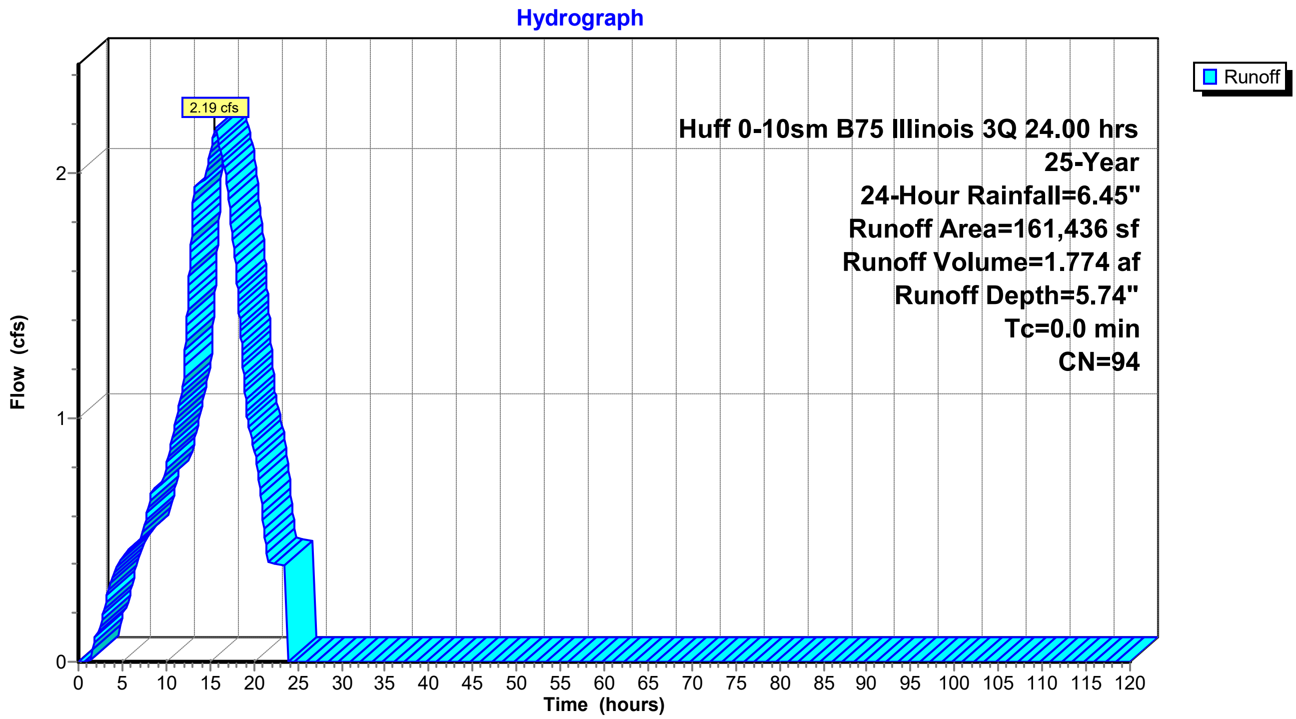
Summary for Subcatchment SC-W: Subcat W

Runoff = 2.19 cfs @ 15.60 hrs, Volume= 1.774 af, Depth= 5.74"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Huff 0-10sm B75 Illinois 3Q 24.00 hrs 25-Year, 24-Hour Rainfall=6.45"

Area (sf)	CN	Description
161,436	94	Newly graded area, HSG D
161,436		100.00% Pervious Area

Subcatchment SC-W: Subcat W



Summary for Pond S-E: East Sump

Inflow Area = 3.49 ac, 0.00% Impervious, Inflow Depth = 5.74" for 25-Year, 24-Hour event
Inflow = 2.06 cfs @ 15.60 hrs, Volume= 1.668 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min

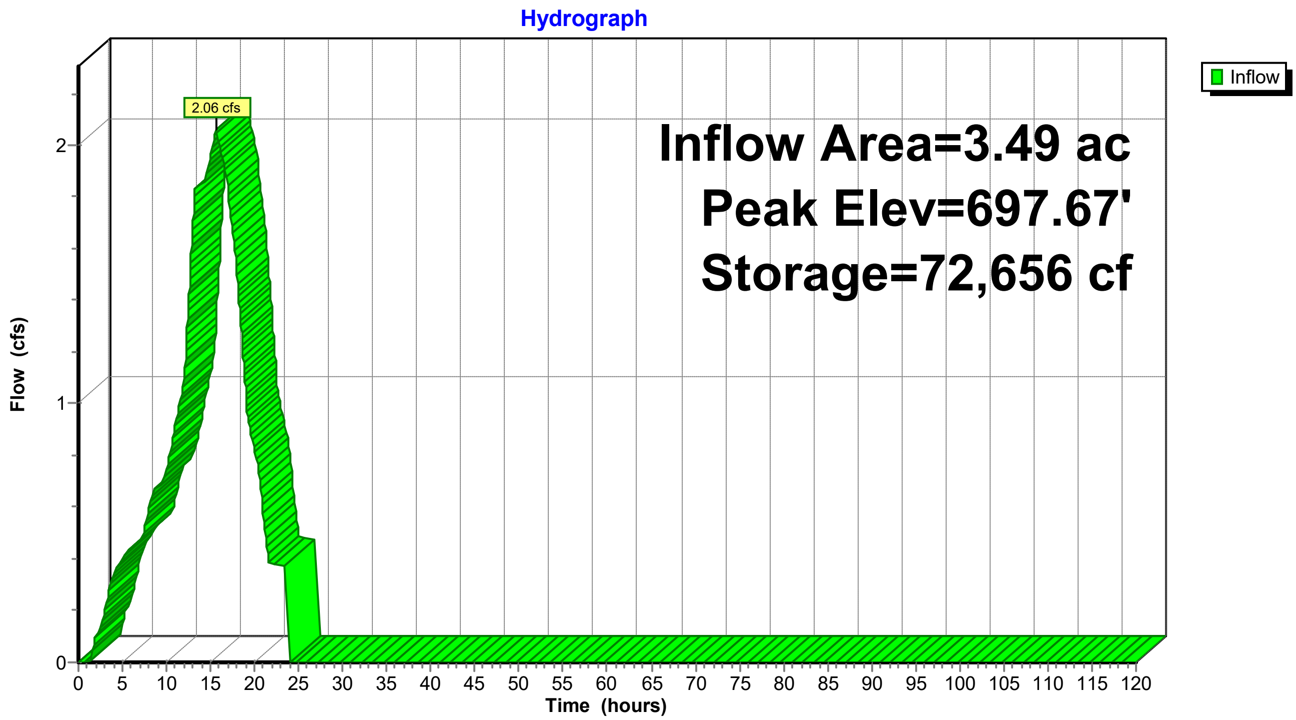
Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Peak Elev= 697.67' @ 24.05 hrs Surf.Area= 24,173 sf Storage= 72,656 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	690.00'	80,846 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
690.00	234	0	0
692.00	2,800	3,034	3,034
694.00	8,494	11,294	14,328
696.00	16,137	24,631	38,959
698.00	25,750	41,887	80,846

Pond S-E: East Sump



Summary for Pond S-W: West Sump

Inflow Area = 3.71 ac, 0.00% Impervious, Inflow Depth = 5.74" for 25-Year, 24-Hour event
Inflow = 2.19 cfs @ 15.60 hrs, Volume= 1.774 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min

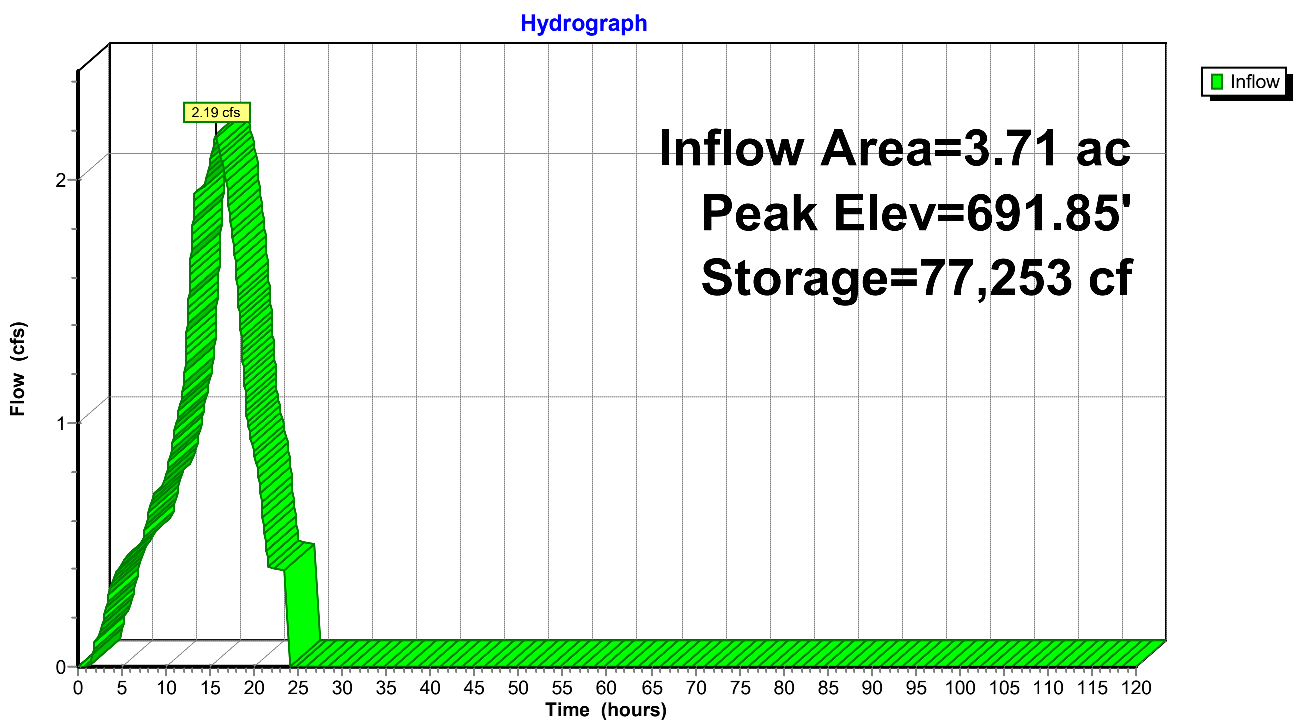
Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Peak Elev= 691.85' @ 24.05 hrs Surf.Area= 25,309 sf Storage= 77,253 cf

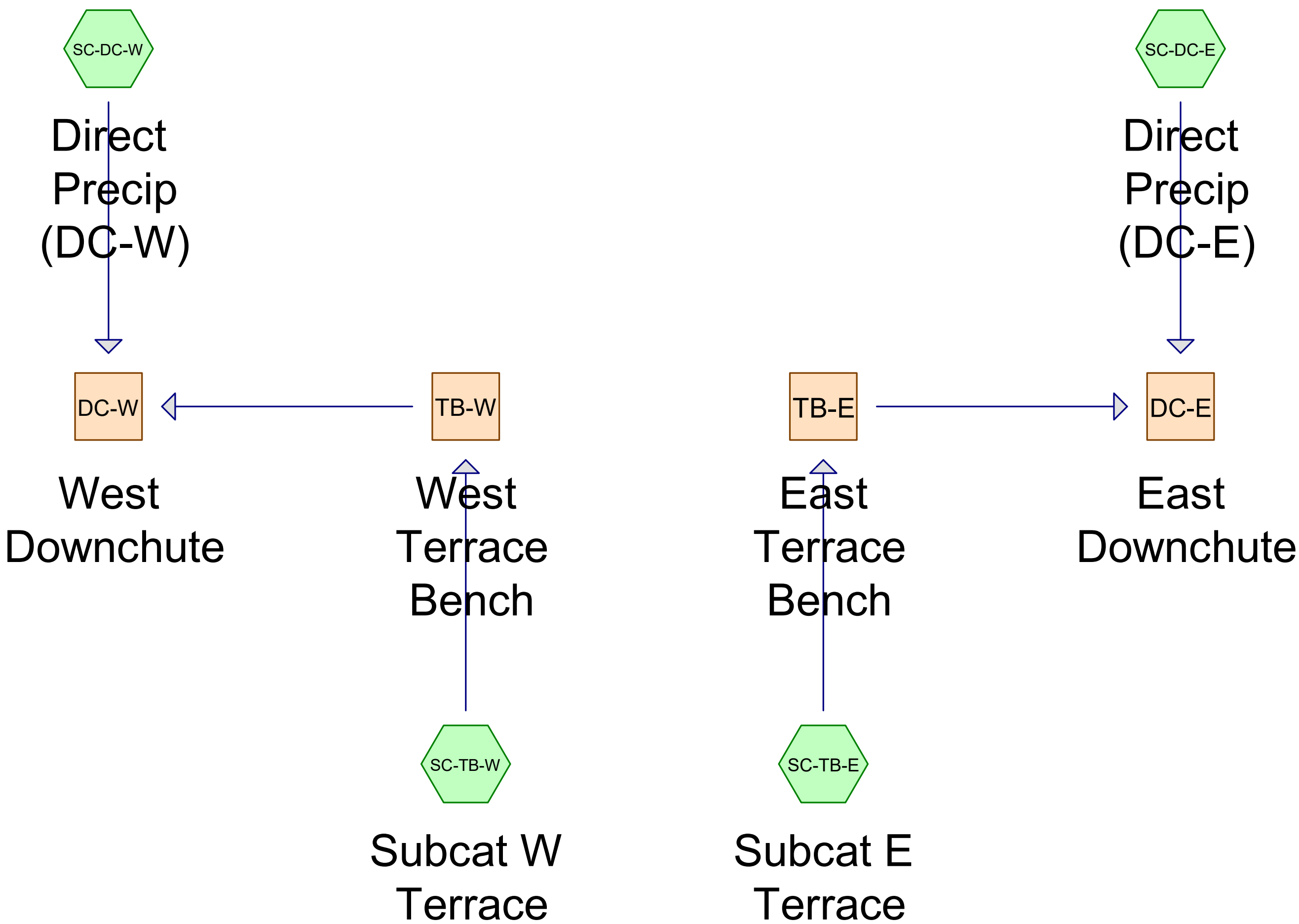
Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no outflow)

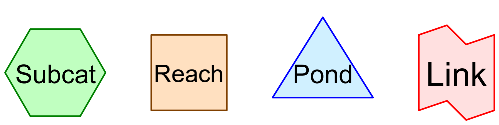
Volume	Invert	Avail.Storage	Storage Description
#1	684.00'	81,158 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
684.00	234	0	0
686.00	2,800	3,034	3,034
688.00	8,494	11,294	14,328
690.00	16,136	24,630	38,958
692.00	26,064	42,200	81,158

Pond S-W: West Sump







Routing Diagram for Zion Site 2 North - Phase D Temporary Terrace Benches and Downchutes
Prepared by APTIM, Printed 12/19/2022
HydroCAD® 10.00-22 s/n 04891 © 2018 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
4.67	94	Newly graded area, HSG D (SC-DC-E, SC-DC-W, SC-TB-E, SC-TB-W)
4.67	**94**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.00	HSG A	
0.00	HSG B	
0.00	HSG C	
4.67	HSG D	SC-DC-E, SC-DC-W, SC-TB-E, SC-TB-W
0.00	Other	
4.67		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.00	0.00	0.00	4.67	0.00	4.67	Newly graded area	SC-DC-E, SC-DC-W, SC-TB-E, SC-TB-W
0.00	**0.00**	**0.00**	**4.67**	**0.00**	**4.67**	**TOTAL AREA**	

Time span=0.00-120.00 hrs, dt=0.05 hrs, 2401 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment SC-DC-E: Direct Precip (DC-E) Runoff Area=1,497 sf 0.00% Impervious Runoff Depth=5.74"
Tc=0.0 min CN=94 Runoff=0.02 cfs 0.016 af

Subcatchment SC-DC-W: Direct Precip Runoff Area=1,633 sf 0.00% Impervious Runoff Depth=5.74"
Tc=0.0 min CN=94 Runoff=0.02 cfs 0.018 af

Subcatchment SC-TB-E: Subcat E Terrace Runoff Area=100,726 sf 0.00% Impervious Runoff Depth=5.74"
Flow Length=330' Slope=0.3333 '/' Tc=1.8 min CN=94 Runoff=1.36 cfs 1.107 af

Subcatchment SC-TB-W: Subcat W Terrace Runoff Area=99,452 sf 0.00% Impervious Runoff Depth=5.74"
Flow Length=330' Slope=0.3333 '/' Tc=1.8 min CN=94 Runoff=1.35 cfs 1.093 af

Reach DC-E: East Downchute Avg. Flow Depth=0.04' Max Vel=4.06 fps Inflow=1.38 cfs 1.123 af
n=0.022 L=150.0' S=0.2533 '/' Capacity=91.36 cfs Outflow=1.38 cfs 1.123 af

Reach DC-W: West Downchute Avg. Flow Depth=0.04' Max Vel=4.02 fps Inflow=1.36 cfs 1.111 af
n=0.022 L=160.0' S=0.2500 '/' Capacity=90.76 cfs Outflow=1.36 cfs 1.111 af

Reach TB-E: East Terrace Bench Avg. Flow Depth=0.31' Max Vel=2.14 fps Inflow=1.36 cfs 1.107 af
n=0.022 L=493.6' S=0.0122 '/' Capacity=347.29 cfs Outflow=1.36 cfs 1.107 af

Reach TB-W: West Terrace Bench Avg. Flow Depth=0.34' Max Vel=1.83 fps Inflow=1.35 cfs 1.093 af
n=0.022 L=493.0' S=0.0081 '/' Capacity=283.74 cfs Outflow=1.34 cfs 1.093 af

Total Runoff Area = 4.67 ac Runoff Volume = 2.234 af Average Runoff Depth = 5.74"
100.00% Pervious = 4.67 ac 0.00% Impervious = 0.00 ac

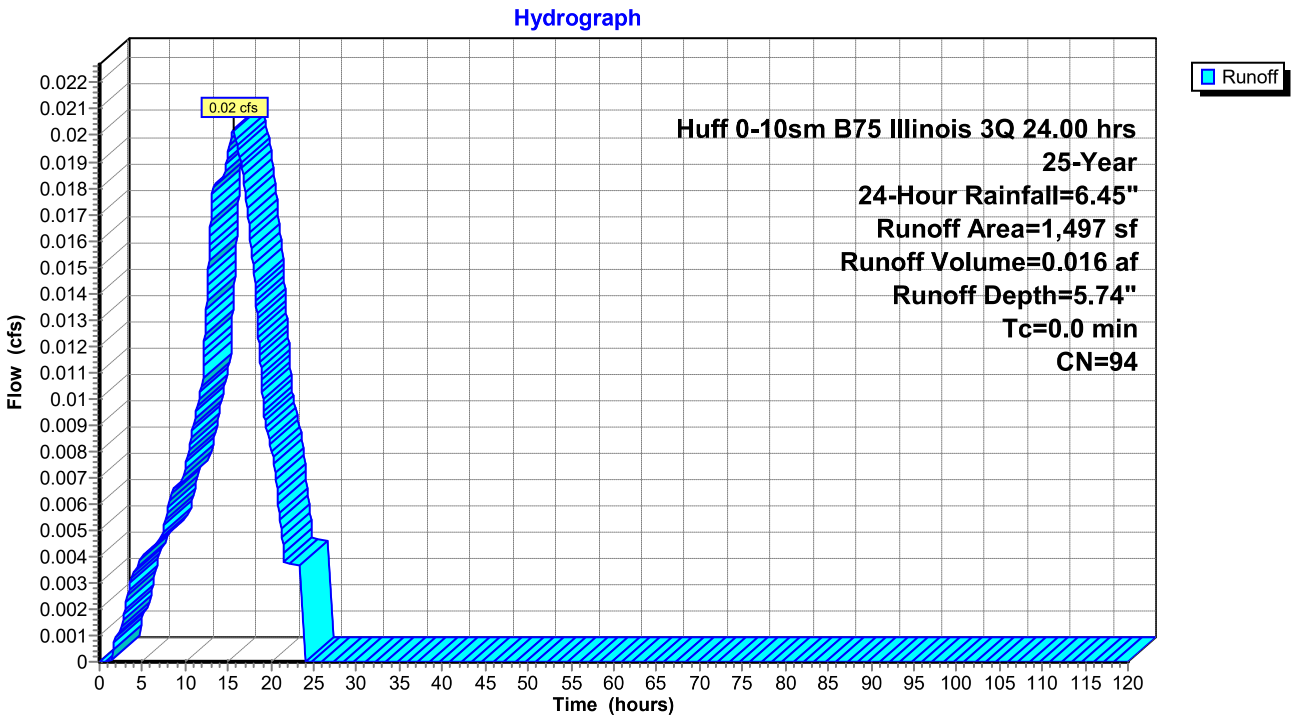
Summary for Subcatchment SC-DC-E: Direct Precip (DC-E)

Runoff = 0.02 cfs @ 15.60 hrs, Volume= 0.016 af, Depth= 5.74"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Huff 0-10sm B75 Illinois 3Q 24.00 hrs 25-Year, 24-Hour Rainfall=6.45"

Area (sf)	CN	Description
1,497	94	Newly graded area, HSG D
1,497		100.00% Pervious Area

Subcatchment SC-DC-E: Direct Precip (DC-E)



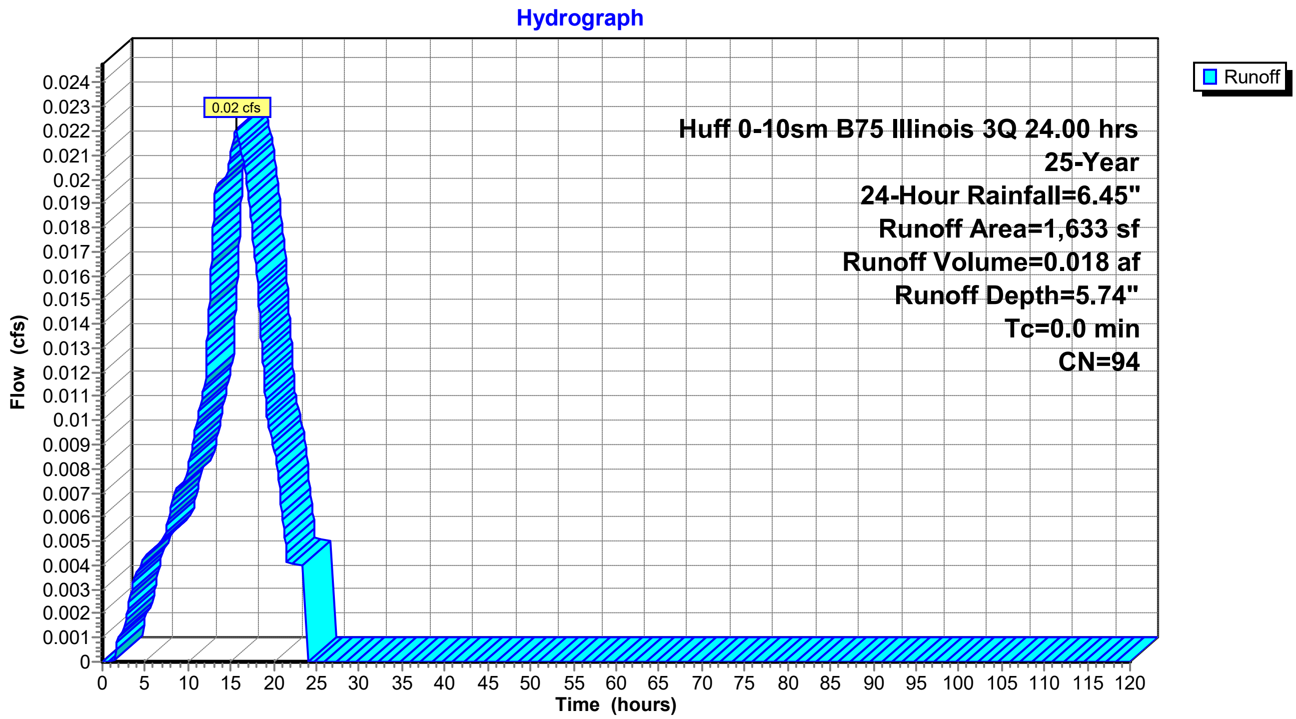
Summary for Subcatchment SC-DC-W: Direct Precip (DC-W)

Runoff = 0.02 cfs @ 15.60 hrs, Volume= 0.018 af, Depth= 5.74"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Huff 0-10sm B75 Illinois 3Q 24.00 hrs 25-Year, 24-Hour Rainfall=6.45"

Area (sf)	CN	Description
1,633	94	Newly graded area, HSG D
1,633		100.00% Pervious Area

Subcatchment SC-DC-W: Direct Precip (DC-W)



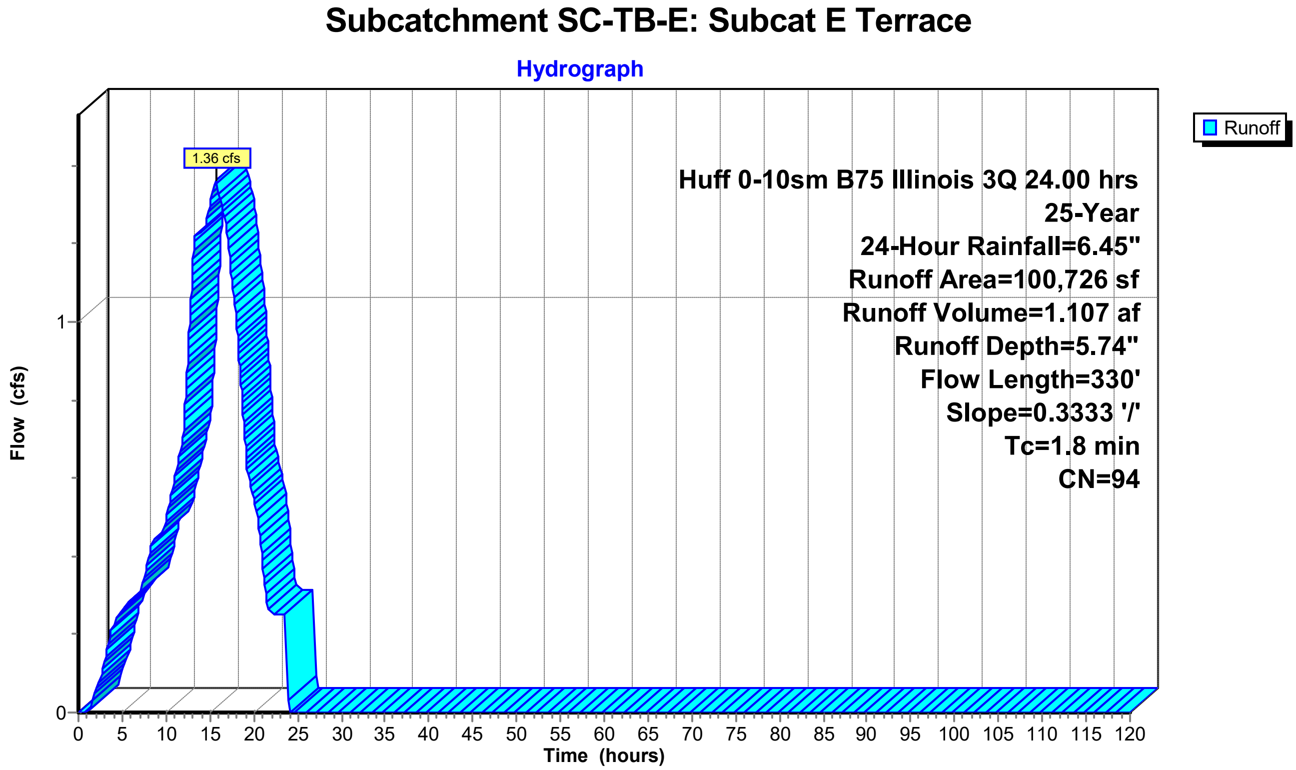
Summary for Subcatchment SC-TB-E: Subcat E Terrace

Runoff = 1.36 cfs @ 15.63 hrs, Volume= 1.107 af, Depth= 5.74"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Huff 0-10sm B75 Illinois 3Q 24.00 hrs 25-Year, 24-Hour Rainfall=6.45"

Area (sf)	CN	Description
100,726	94	Newly graded area, HSG D
100,726		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.4	100	0.3333	1.18		**Sheet Flow,** Fallow n= 0.050 P2= 2.80"
0.4	230	0.3333	9.29		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
1.8	330	Total			



Summary for Subcatchment SC-TB-W: Subcat W Terrace

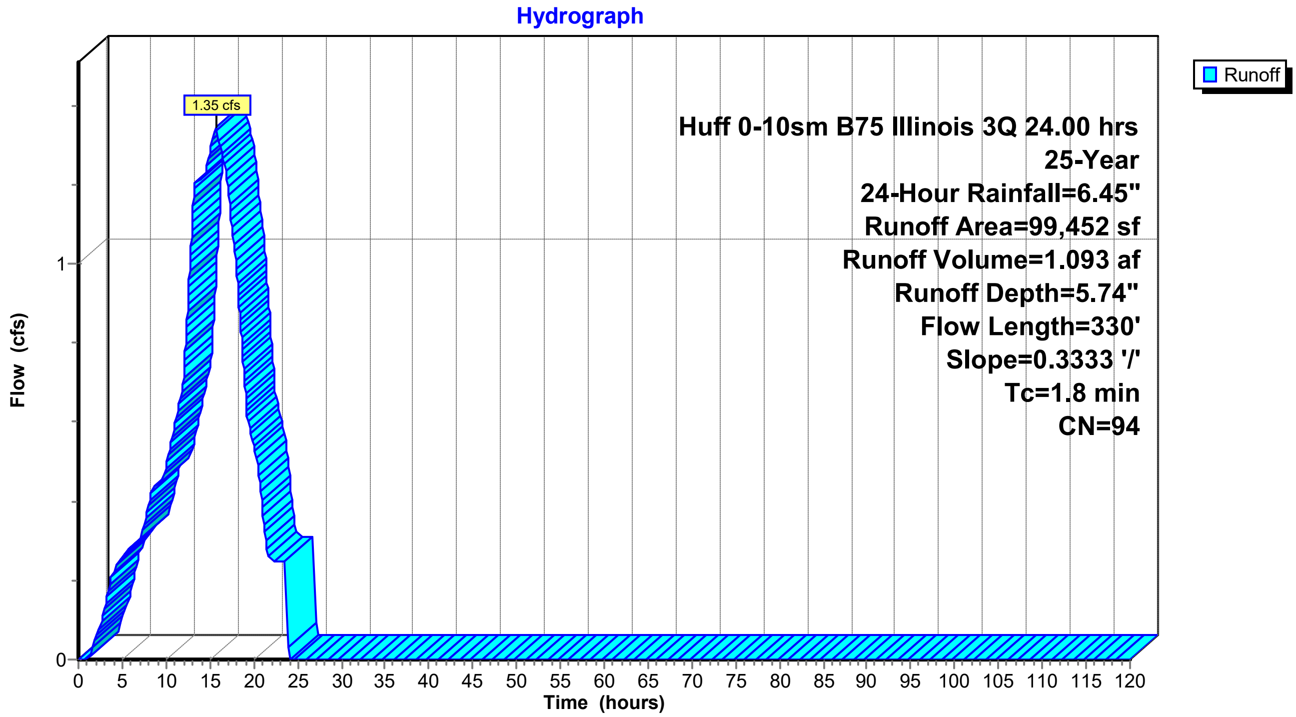
Runoff = 1.35 cfs @ 15.63 hrs, Volume= 1.093 af, Depth= 5.74"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Huff 0-10sm B75 Illinois 3Q 24.00 hrs 25-Year, 24-Hour Rainfall=6.45"

Area (sf)	CN	Description
99,452	94	Newly graded area, HSG D
99,452		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.4	100	0.3333	1.18		**Sheet Flow,** Fallow n= 0.050 P2= 2.80"
0.4	230	0.3333	9.29		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
1.8	330	Total			

Subcatchment SC-TB-W: Subcat W Terrace



Summary for Reach DC-E: East Downchute

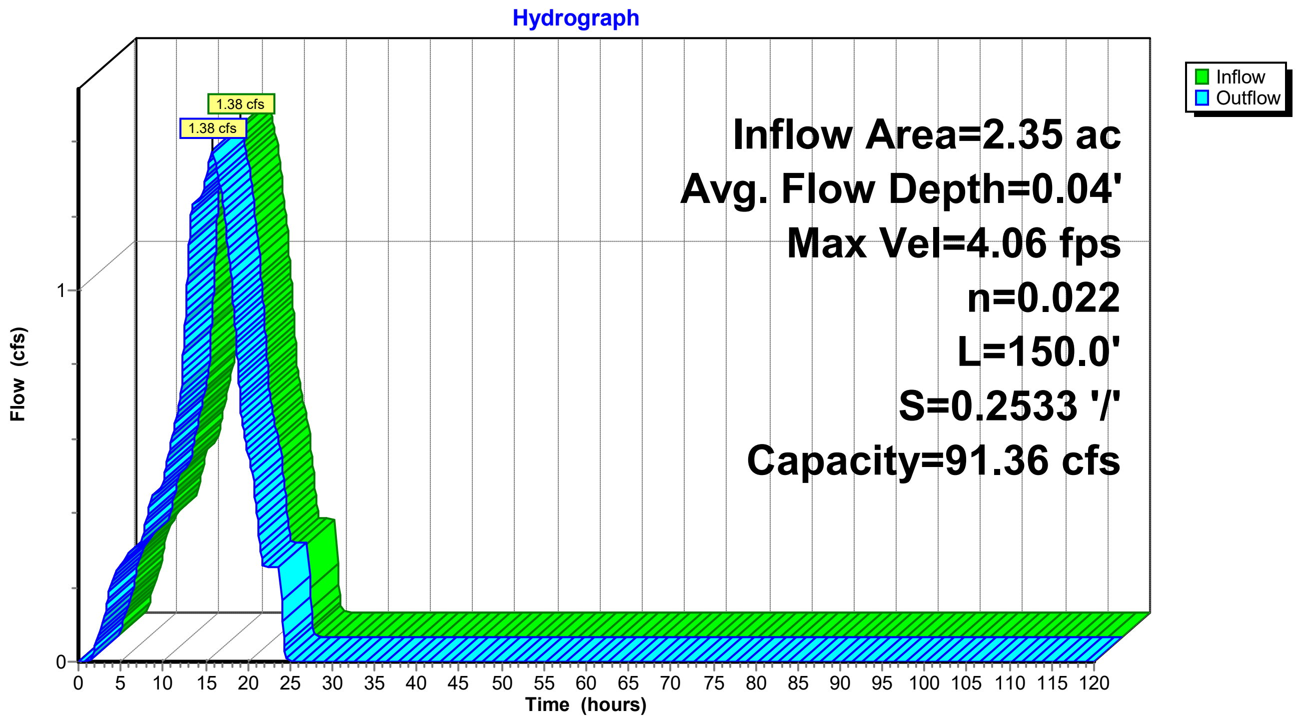
Inflow Area = 2.35 ac, 0.00% Impervious, Inflow Depth = 5.74" for 25-Year, 24-Hour event
Inflow = 1.38 cfs @ 15.74 hrs, Volume= 1.123 af
Outflow = 1.38 cfs @ 15.76 hrs, Volume= 1.123 af, Atten= 0%, Lag= 1.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.06 fps, Min. Travel Time= 0.6 min
Avg. Velocity = 2.63 fps, Avg. Travel Time= 1.0 min

Peak Storage= 51 cf @ 15.75 hrs
Average Depth at Peak Storage= 0.04'
Bank-Full Depth= 0.50' Flow Area= 4.8 sf, Capacity= 91.36 cfs

8.00' x 0.50' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 3.0 '/' Top Width= 11.00'
Length= 150.0' Slope= 0.2533 '/'
Inlet Invert= 788.00', Outlet Invert= 750.00'

Reach DC-E: East Downchute



Summary for Reach DC-W: West Downchute

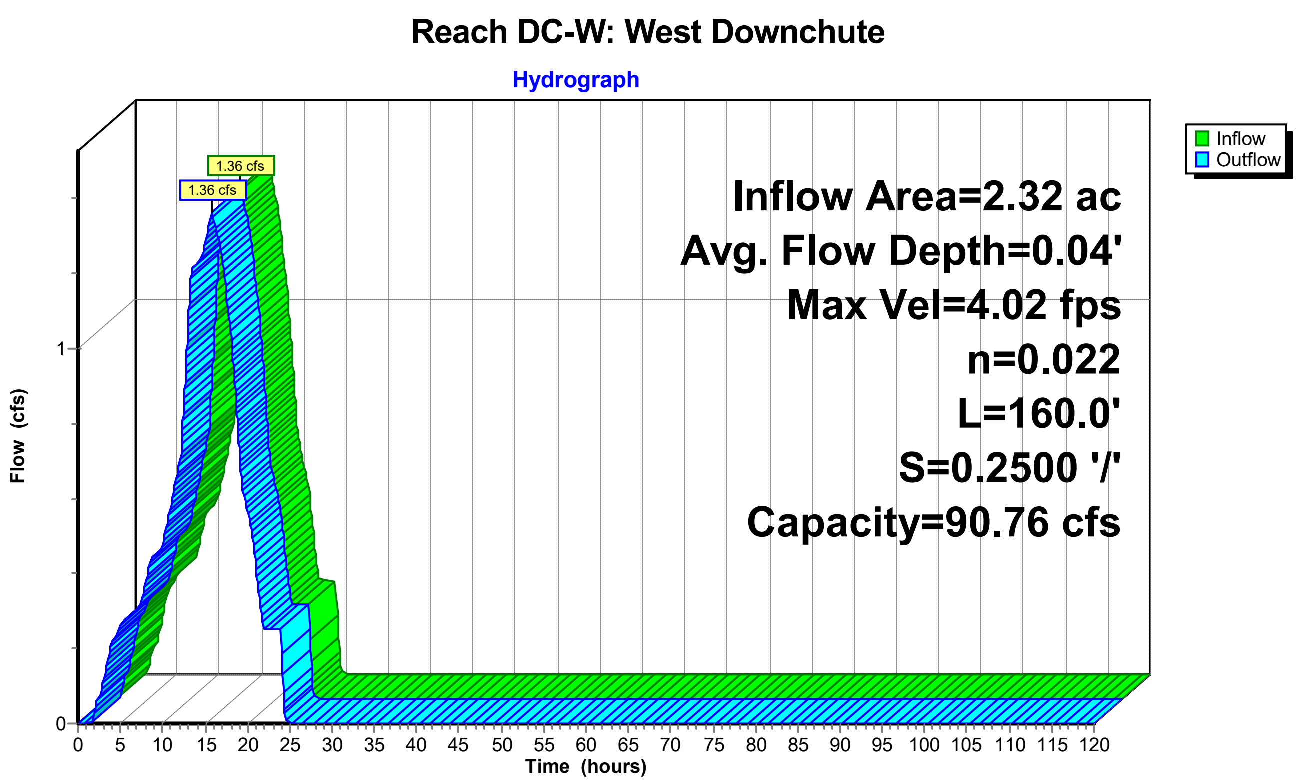
Inflow Area = 2.32 ac, 0.00% Impervious, Inflow Depth = 5.74" for 25-Year, 24-Hour event
Inflow = 1.36 cfs @ 15.76 hrs, Volume= 1.111 af
Outflow = 1.36 cfs @ 15.77 hrs, Volume= 1.111 af, Atten= 0%, Lag= 1.1 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.02 fps, Min. Travel Time= 0.7 min
Avg. Velocity = 2.59 fps, Avg. Travel Time= 1.0 min

Peak Storage= 54 cf @ 15.76 hrs
Average Depth at Peak Storage= 0.04'
Bank-Full Depth= 0.50' Flow Area= 4.8 sf, Capacity= 90.76 cfs

8.00' x 0.50' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 3.0 '/' Top Width= 11.00'
Length= 160.0' Slope= 0.2500 '/'
Inlet Invert= 790.00', Outlet Invert= 750.00'

‡



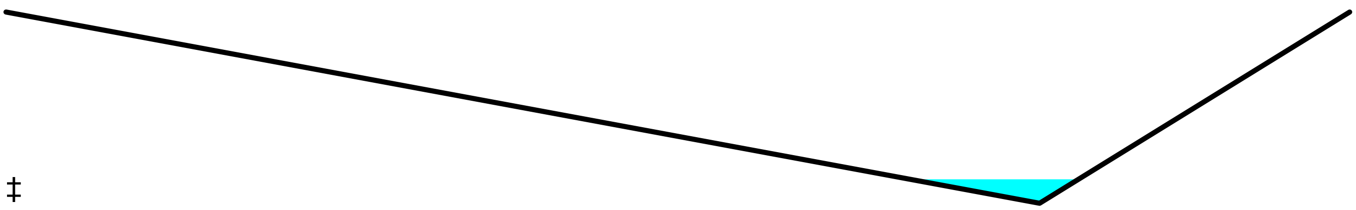
Summary for Reach TB-E: East Terrace Bench

Inflow Area = 2.31 ac, 0.00% Impervious, Inflow Depth = 5.74" for 25-Year, 24-Hour event
Inflow = 1.36 cfs @ 15.63 hrs, Volume= 1.107 af
Outflow = 1.36 cfs @ 15.74 hrs, Volume= 1.107 af, Atten= 0%, Lag= 6.5 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.14 fps, Min. Travel Time= 3.8 min
Avg. Velocity = 1.56 fps, Avg. Travel Time= 5.3 min

Peak Storage= 314 cf @ 15.67 hrs
Average Depth at Peak Storage= 0.31'
Bank-Full Depth= 2.50' Flow Area= 40.6 sf, Capacity= 347.29 cfs

0.00' x 2.50' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 10.0 3.0 '/' Top Width= 32.50'
Length= 493.6' Slope= 0.0122 '/'
Inlet Invert= 794.00', Outlet Invert= 788.00'



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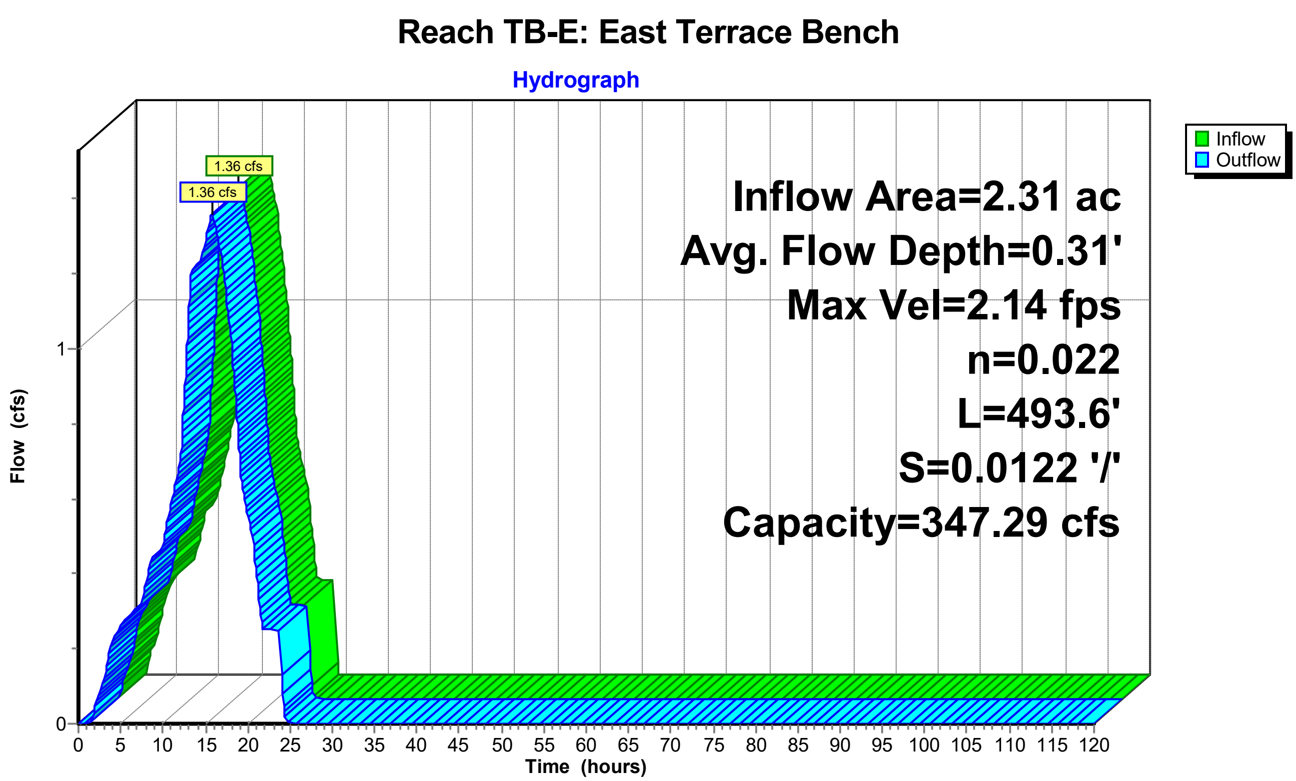


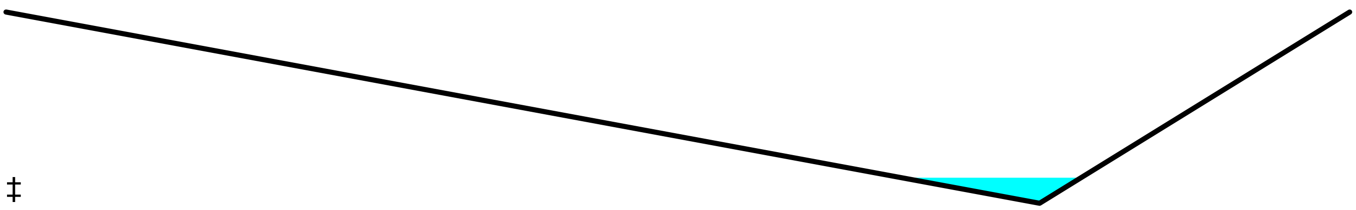
Summary for Reach TB-W: West Terrace Bench

Inflow Area = 2.28 ac, 0.00% Impervious, Inflow Depth = 5.74" for 25-Year, 24-Hour event
Inflow = 1.35 cfs @ 15.63 hrs, Volume= 1.093 af
Outflow = 1.34 cfs @ 15.76 hrs, Volume= 1.093 af, Atten= 0%, Lag= 7.5 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.83 fps, Min. Travel Time= 4.5 min
Avg. Velocity = 1.32 fps, Avg. Travel Time= 6.2 min

Peak Storage= 361 cf @ 15.68 hrs
Average Depth at Peak Storage= 0.34'
Bank-Full Depth= 2.50' Flow Area= 40.6 sf, Capacity= 283.74 cfs

0.00' x 2.50' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 10.0 3.0 '/' Top Width= 32.50'
Length= 493.0' Slope= 0.0081 '/'
Inlet Invert= 794.00', Outlet Invert= 790.00'



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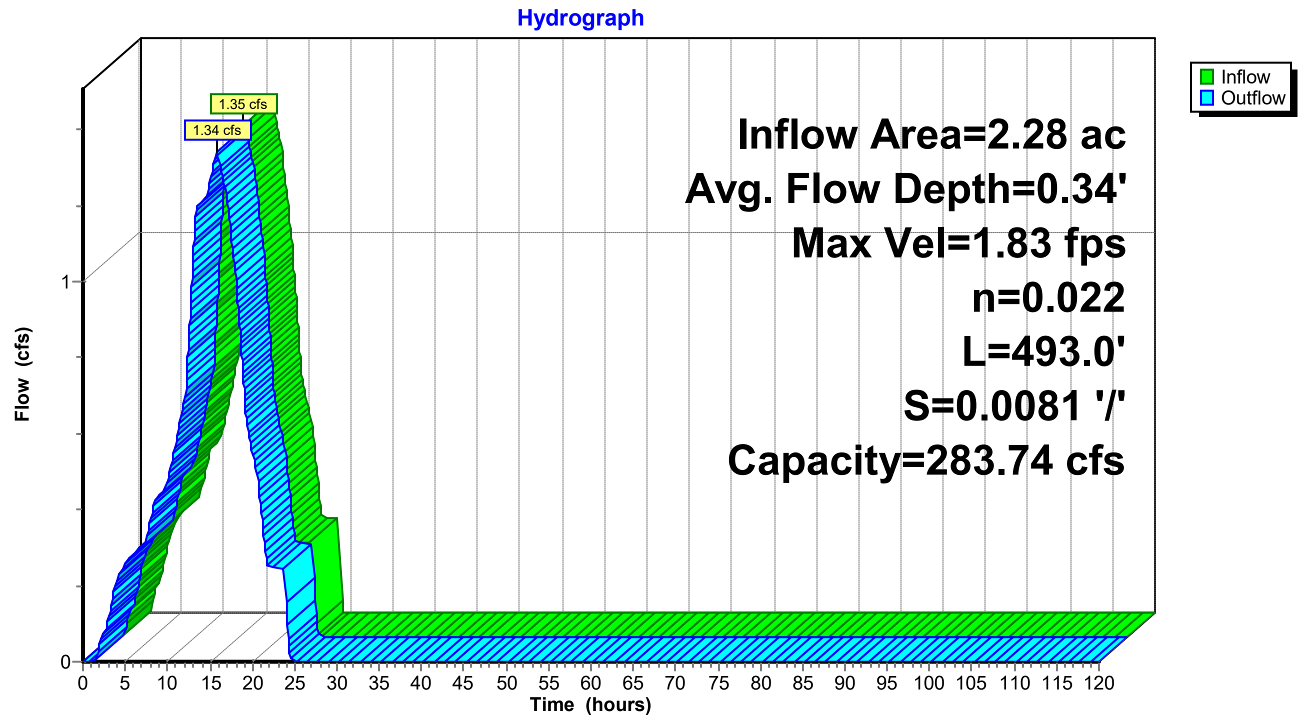
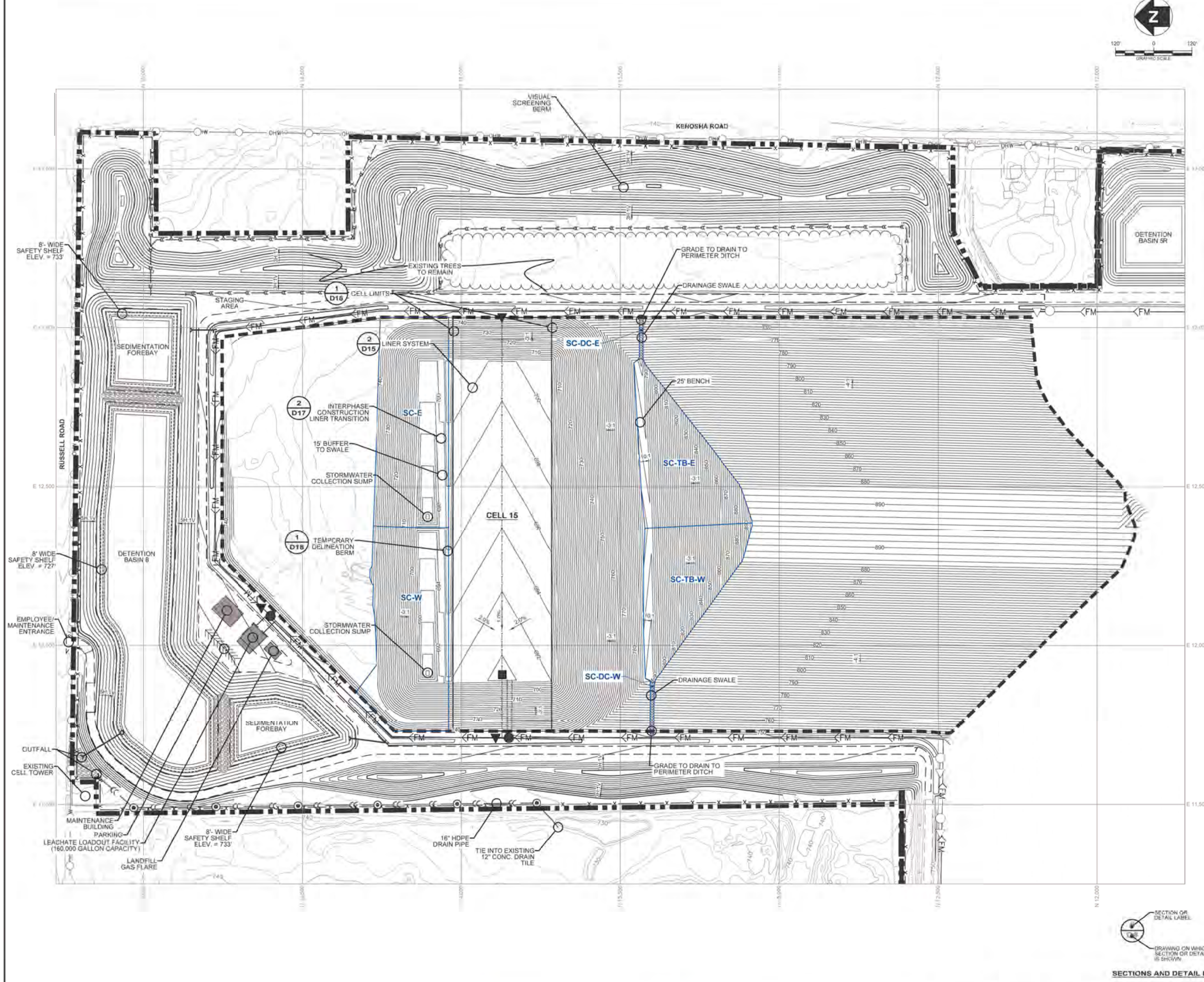
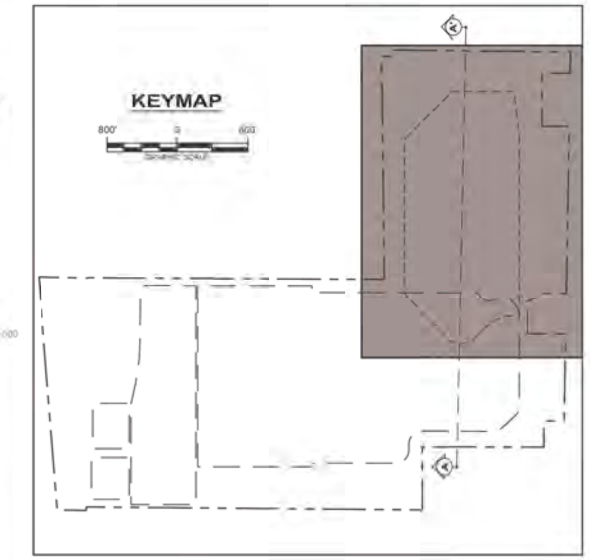
Reach TB-W: West Terrace Bench



Phase E
25-year, 24-hour HydroCAD Outputs





LEGEND

- APPROXIMATE FACILITY BOUNDARY
- APPROXIMATE EXISTING WASTE BOUNDARY
- APPROXIMATE PROPOSED EXPANSION WASTE BOUNDARY
- EXISTING CONTOUR
- EXISTING ROAD
- EXISTING VEGETATION
- EXISTING FENCE
- EXISTING CULVERT
- PROPOSED GROUND SURFACE ELEVATION CONTOUR (FEET-MSL)
- PROPOSED ROAD
- PROPOSED CULVERT
- EXISTING FORCEMAIN
- EXISTING LEACHATE COLLECTION PIPE
- EXISTING LEACHATE CLEANOUT LOCATION
- EXISTING LEACHATE VAULT LOCATION
- EXISTING LEACHATE COLLECTION SUMP LOCATION
- PROPOSED FORCEMAIN
- PROPOSED LEACHATE COLLECTION PIPE
- PROPOSED LEACHATE CLEANOUT LOCATION
- PROPOSED LEACHATE VAULT/MANHOLE LOCATION
- PROPOSED LEACHATE COLLECTION SUMP LOCATION
- PROPOSED DRAIN TILE
- STORMWATER MANHOLE
- STORMWATER HEADWALL
- SUBCATCHMENT BOUNDARY

NOTES

1. EXISTING CONTOURS DEVELOPED FROM SITE AERIAL TOPOGRAPHIC SURVEY BY CQM, INC. ON 10/22/2018 EXCEPT STORMWATER MANAGEMENT FEATURES ASSOCIATED WITH SITE 2 EAST (DITCHES AND BASIN 5R). STORMWATER DESIGN GRADES ARE SHOWN FOR THESE FEATURES FOR COMPLETENESS, AS NOT ALL GRADES ARE CAPTURED BY THE TOPOGRAPHIC SURVEY.
2. CURRENT TOPOGRAPHY MAY DIFFER FROM THAT SHOWN.
3. FOR CLARITY, NOT ALL SITE FEATURES MAY BE SHOWN.
4. CELL DEVELOPMENT WILL PROCEED IN NUMERICAL ORDER. VERTICAL EXPANSION WILL PROGRESS CONCURRENT WITH CELL 11 DEVELOPMENT.
5. THE TEMPORARY STORMWATER COLLECTION SUMP AND ASSOCIATED DITCH SHOWN ALONG THE NORTHERN EDGE OF THE NEWLY CONSTRUCTED CELL REPRESENTS A TYPICAL INTERIM STORMWATER MANAGEMENT SYSTEM DURING CELL CONSTRUCTION. ACTUAL INTERIM STORMWATER MANAGEMENT STRUCTURES MAY DIFFER FROM WHAT IS SHOWN BASED ON OPERATIONAL NEEDS.
6. THE TEMPORARY TERRACE BENCH AND DRAINAGE DITCH SHOWN ALONG THE OPERATIONAL SLOPE OF THE LANDFILL REPRESENTS A TYPICAL INTERIM STORMWATER MANAGEMENT FEATURE. TEMPORARY TERRACE BENCHES MAY BE USED TO COLLECT STORMWATER FROM AREAS OF THE OPERATIONAL SLOPE WHERE INTERMEDIATE COVER HAS BEEN APPLIED. INTERIM STORMWATER MANAGEMENT STRUCTURES MAY DIFFER FROM WHAT IS SHOWN BASED ON OPERATIONAL NEEDS.
7. INTERIM STORMWATER MANAGEMENT STRUCTURES MAY BE MODIFIED TO ACCOMMODATE CONSTRUCTION ACTIVITIES AS THEY PROGRESS, AND SHOULD BE APPROPRIATELY SIZED TO MANAGE STORMWATER RUNOFF DURING CONSTRUCTION.
8. THE ANTICIPATED CONSTRUCTION PHASING DEPICTED IN THIS DRAWING IS SUBJECT TO CHANGE BASED ON OPERATIONAL NEEDS.

SECTION OR DETAIL LABEL
DRAWING ON WHICH SECTION OR DETAIL IS SHOWN

SECTIONS AND DETAIL KEY

REV. NO.	DATE	DESCRIPTION

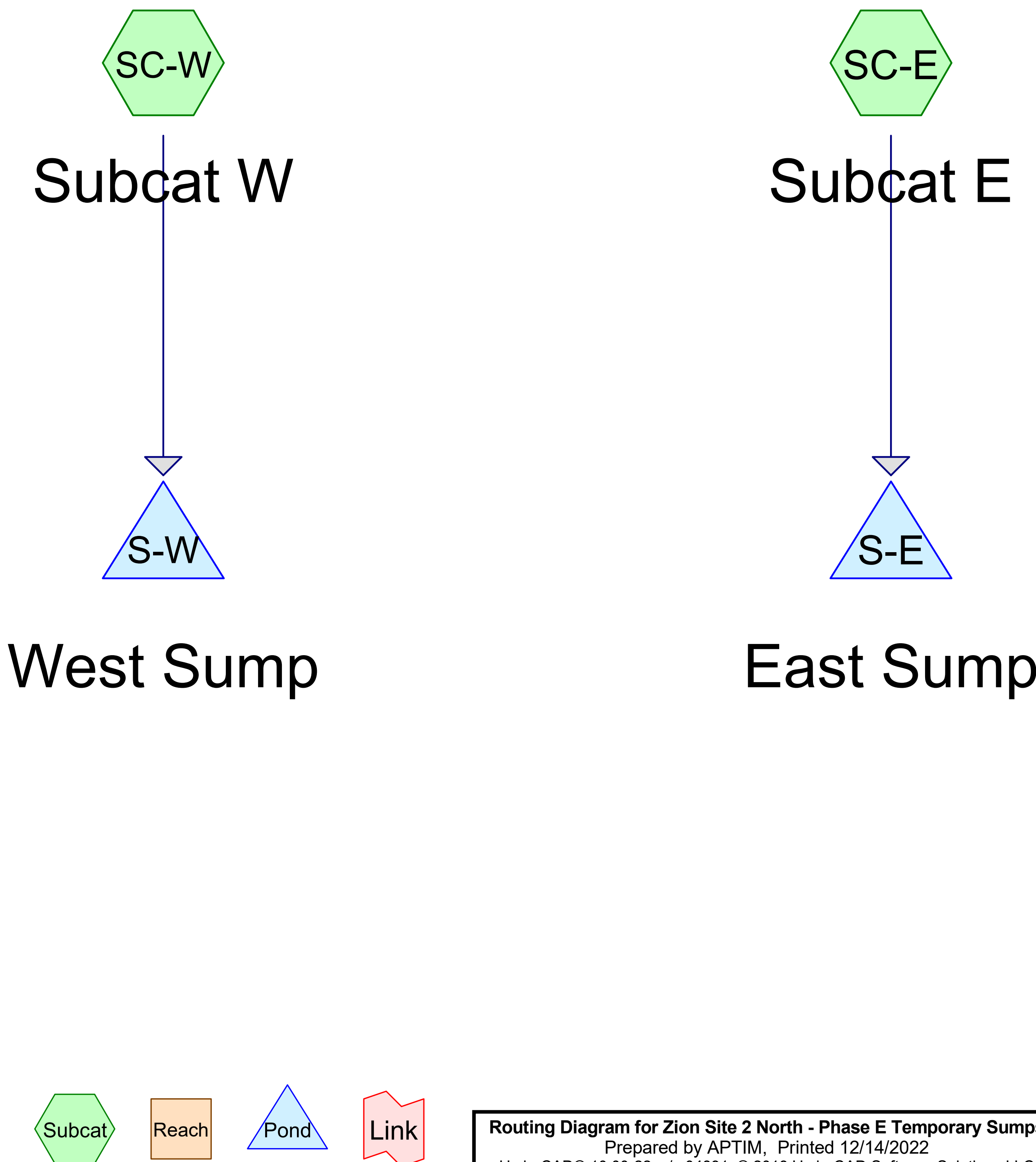
GFL GREEN FOR LIFE environmental

APTIM Environmental & Infrastructure, LLC

ZION LANDFILL - SITE 2 NORTH EXPANSION
CITY OF ZION, ILLINOIS

LANDFILL PHASING PLAN - PHASE E
TEMPORARY STORMWATER CONVEYANCE STRUCTURES
SUBCATCHMENT DELINEATION

PROJ. NO.:	631020105	DATE:	DECEMBER 2022
DESIGNED BY:	DAM/BWM/KM	DRAWING NO.	
DRAWN BY:	BWM/NV/KM		5
CHECKED BY:	DAM		
APPROVED BY:	DAM		5 OF 7 SHEETS



Routing Diagram for Zion Site 2 North - Phase E Temporary Sumps
Prepared by APTIM, Printed 12/14/2022

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
6.88	94	Newly graded area, HSG D (SC-E, SC-W)
6.88	**94**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.00	HSG A	
0.00	HSG B	
0.00	HSG C	
6.88	HSG D	SC-E, SC-W
0.00	Other	
6.88		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.00	0.00	0.00	6.88	0.00	6.88	Newly graded area	SC-E, SC-W
0.00	**0.00**	**0.00**	**6.88**	**0.00**	**6.88**	**TOTAL AREA**	

Time span=0.00-120.00 hrs, dt=0.05 hrs, 2401 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment SC-E: Subcat E Runoff Area=147,402 sf 0.00% Impervious Runoff Depth=5.74"
Tc=0.0 min CN=94 Runoff=2.00 cfs 1.619 af

Subcatchment SC-W: Subcat W Runoff Area=152,481 sf 0.00% Impervious Runoff Depth=5.74"
Tc=0.0 min CN=94 Runoff=2.06 cfs 1.675 af

Pond S-E: East Sump Peak Elev=697.88' Storage=70,535 cf Inflow=2.00 cfs 1.619 af
Outflow=0.00 cfs 0.000 af

Pond S-W: West Sump Peak Elev=691.97' Storage=72,966 cf Inflow=2.06 cfs 1.675 af
Outflow=0.00 cfs 0.000 af

Total Runoff Area = 6.88 ac Runoff Volume = 3.294 af Average Runoff Depth = 5.74"
100.00% Pervious = 6.88 ac 0.00% Impervious = 0.00 ac

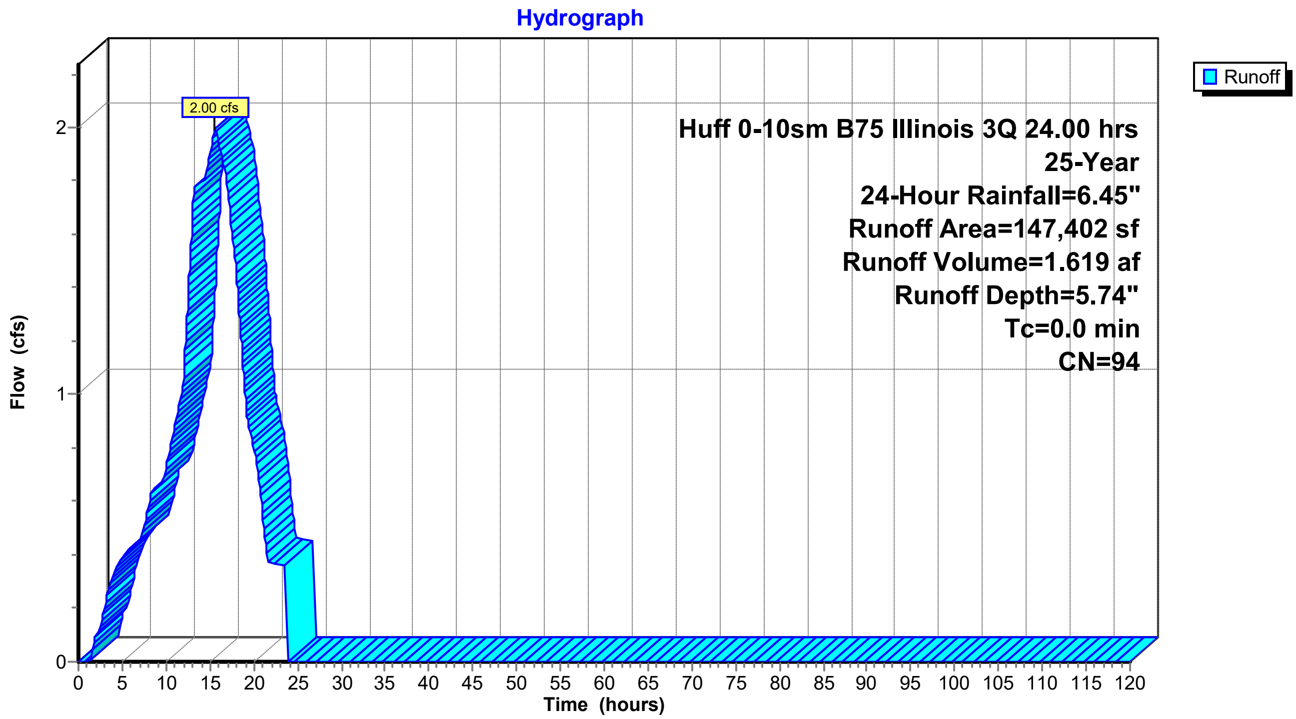
Summary for Subcatchment SC-E: Subcat E

Runoff = 2.00 cfs @ 15.60 hrs, Volume= 1.619 af, Depth= 5.74"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Huff 0-10sm B75 Illinois 3Q 24.00 hrs 25-Year, 24-Hour Rainfall=6.45"

Area (sf)	CN	Description
147,402	94	Newly graded area, HSG D
147,402		100.00% Pervious Area

Subcatchment SC-E: Subcat E



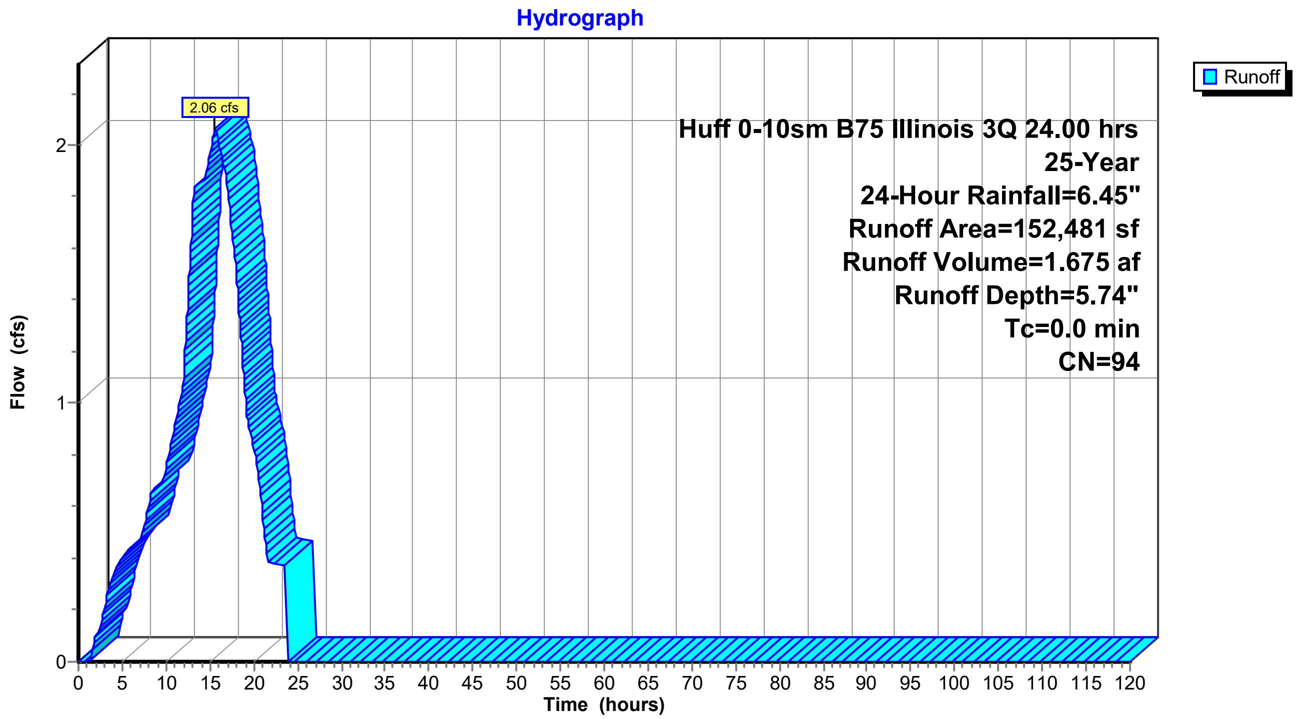
Summary for Subcatchment SC-W: Subcat W

Runoff = 2.06 cfs @ 15.60 hrs, Volume= 1.675 af, Depth= 5.74"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Huff 0-10sm B75 Illinois 3Q 24.00 hrs 25-Year, 24-Hour Rainfall=6.45"

Area (sf)	CN	Description
152,481	94	Newly graded area, HSG D
152,481		100.00% Pervious Area

Subcatchment SC-W: Subcat W



Summary for Pond S-E: East Sump

Inflow Area = 3.38 ac, 0.00% Impervious, Inflow Depth = 5.74" for 25-Year, 24-Hour event
Inflow = 2.00 cfs @ 15.60 hrs, Volume= 1.619 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min

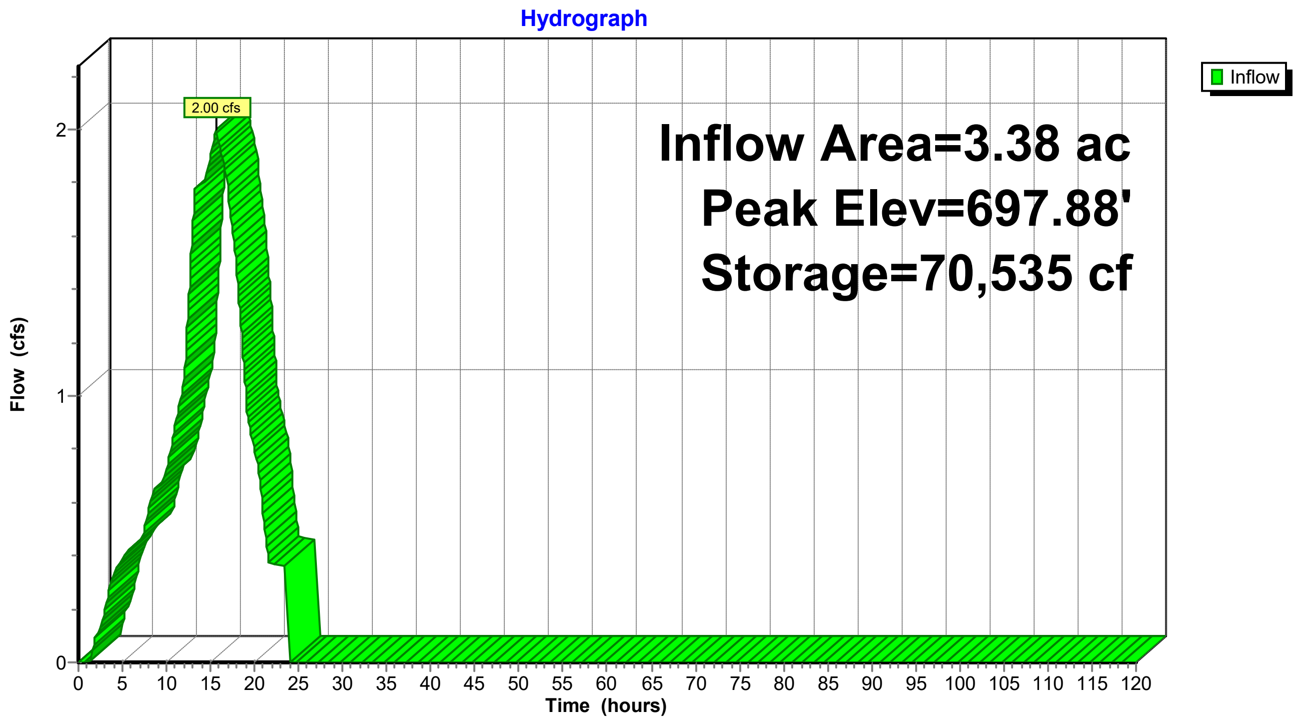
Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Peak Elev= 697.88' @ 24.05 hrs Surf.Area= 23,208 sf Storage= 70,535 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	690.00'	73,396 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
690.00	157	0	0
692.00	2,433	2,590	2,590
694.00	7,598	10,031	12,621
696.00	14,709	22,307	34,928
698.00	23,759	38,468	73,396

Pond S-E: East Sump



Summary for Pond S-W: West Sump

Inflow Area = 3.50 ac, 0.00% Impervious, Inflow Depth = 5.74" for 25-Year, 24-Hour event
Inflow = 2.06 cfs @ 15.60 hrs, Volume= 1.675 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min

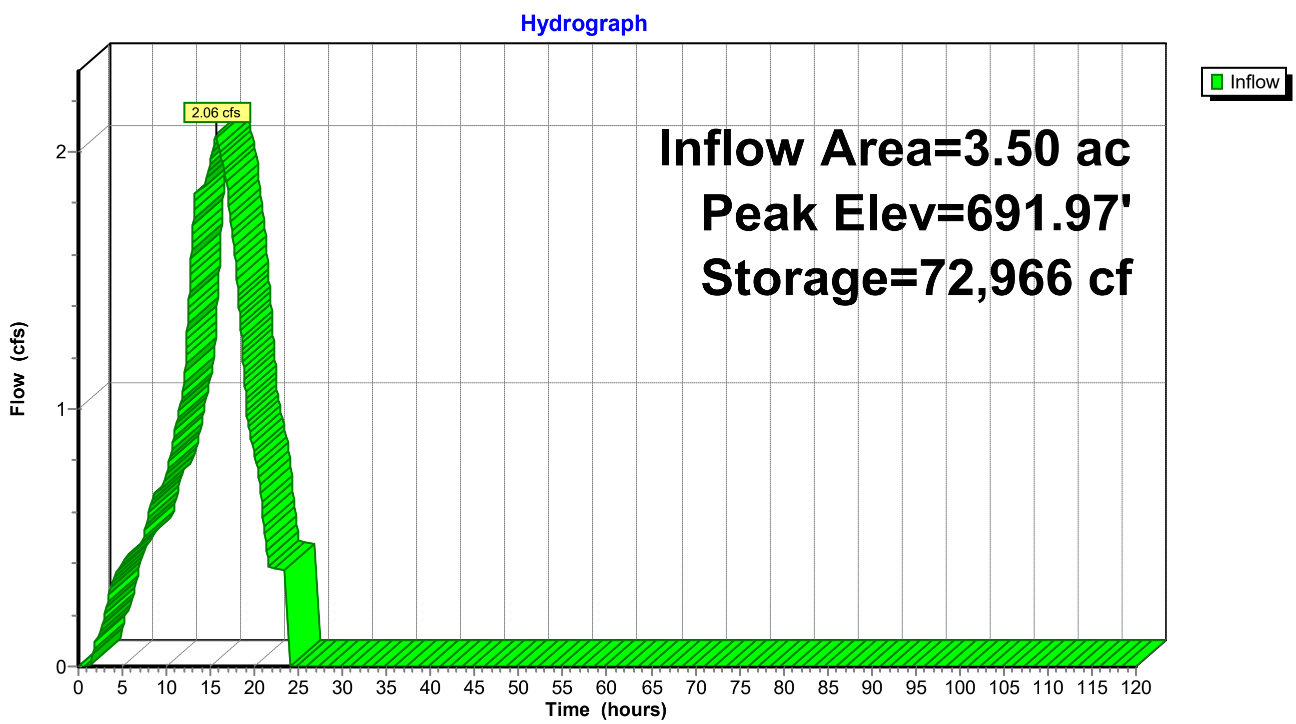
Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Peak Elev= 691.97' @ 24.05 hrs Surf.Area= 23,955 sf Storage= 72,966 cf

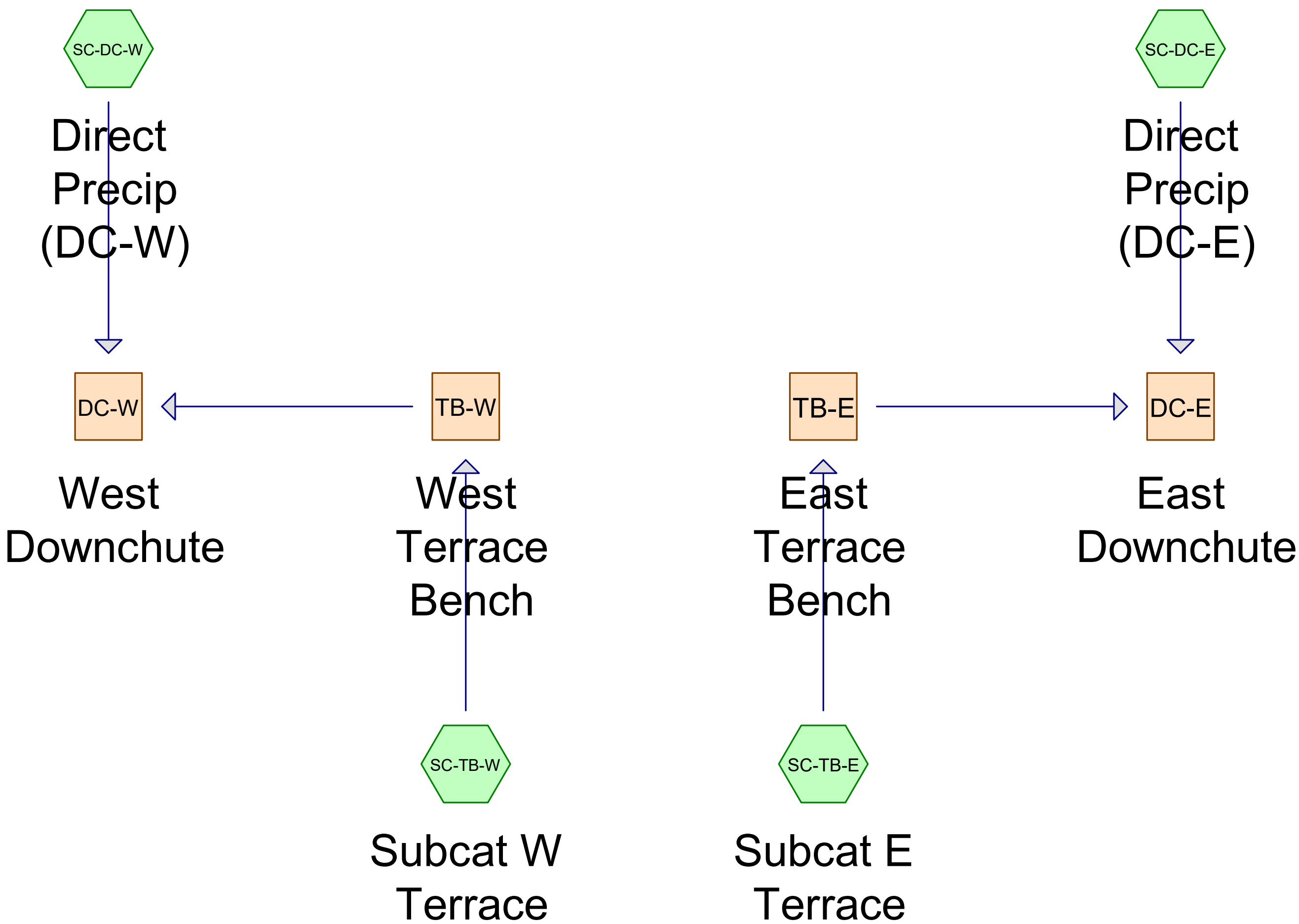
Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no outflow)

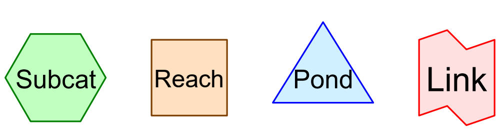
Volume	Invert	Avail.Storage	Storage Description
#1	684.00'	73,744 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
684.00	157	0	0
686.00	2,433	2,590	2,590
688.00	7,598	10,031	12,621
690.00	14,709	22,307	34,928
692.00	24,107	38,816	73,744

Pond S-W: West Sump







Routing Diagram for Zion Site 2 North - Phase E Temporary Terrace Benches and Downchutes
Prepared by APTIM, Printed 12/22/2022
HydroCAD® 10.00-22 s/n 04891 © 2018 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
4.87	94	Newly graded area, HSG D (SC-DC-E, SC-DC-W, SC-TB-E, SC-TB-W)
4.87	**94**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.00	HSG A	
0.00	HSG B	
0.00	HSG C	
4.87	HSG D	SC-DC-E, SC-DC-W, SC-TB-E, SC-TB-W
0.00	Other	
4.87		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.00	0.00	0.00	4.87	0.00	4.87	Newly graded area	SC-DC-E, SC-DC-W, SC-TB-E, SC-TB-W
0.00	**0.00**	**0.00**	**4.87**	**0.00**	**4.87**	**TOTAL AREA**	

Time span=0.00-120.00 hrs, dt=0.05 hrs, 2401 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment SC-DC-E: Direct Precip (DC-E) Runoff Area=1,427 sf 0.00% Impervious Runoff Depth=5.74"
Tc=0.0 min CN=94 Runoff=0.02 cfs 0.016 af

Subcatchment SC-DC-W: Direct Precip Runoff Area=1,492 sf 0.00% Impervious Runoff Depth=5.74"
Tc=0.0 min CN=94 Runoff=0.02 cfs 0.016 af

Subcatchment SC-TB-E: Subcat E Terrace Runoff Area=108,500 sf 0.00% Impervious Runoff Depth=5.74"
Flow Length=336' Slope=0.3333 '/' Tc=1.8 min CN=94 Runoff=1.47 cfs 1.192 af

Subcatchment SC-TB-W: Subcat W Terrace Runoff Area=100,551 sf 0.00% Impervious Runoff Depth=5.74"
Flow Length=336' Slope=0.3333 '/' Tc=1.8 min CN=94 Runoff=1.36 cfs 1.105 af

Reach DC-E: East Downchute Avg. Flow Depth=0.04' Max Vel=4.16 fps Inflow=1.48 cfs 1.208 af
n=0.022 L=140.0' S=0.2500 '/' Capacity=90.76 cfs Outflow=1.48 cfs 1.208 af

Reach DC-W: West Downchute Avg. Flow Depth=0.04' Max Vel=4.02 fps Inflow=1.38 cfs 1.121 af
n=0.022 L=150.0' S=0.2467 '/' Capacity=90.15 cfs Outflow=1.38 cfs 1.121 af

Reach TB-E: East Terrace Bench Avg. Flow Depth=0.32' Max Vel=2.25 fps Inflow=1.47 cfs 1.192 af
n=0.022 L=530.0' S=0.0132 '/' Capacity=362.01 cfs Outflow=1.46 cfs 1.192 af

Reach TB-W: West Terrace Bench Avg. Flow Depth=0.30' Max Vel=2.26 fps Inflow=1.36 cfs 1.105 af
n=0.022 L=495.5' S=0.0141 '/' Capacity=374.40 cfs Outflow=1.36 cfs 1.105 af

Total Runoff Area = 4.87 ac Runoff Volume = 2.329 af Average Runoff Depth = 5.74"
100.00% Pervious = 4.87 ac 0.00% Impervious = 0.00 ac

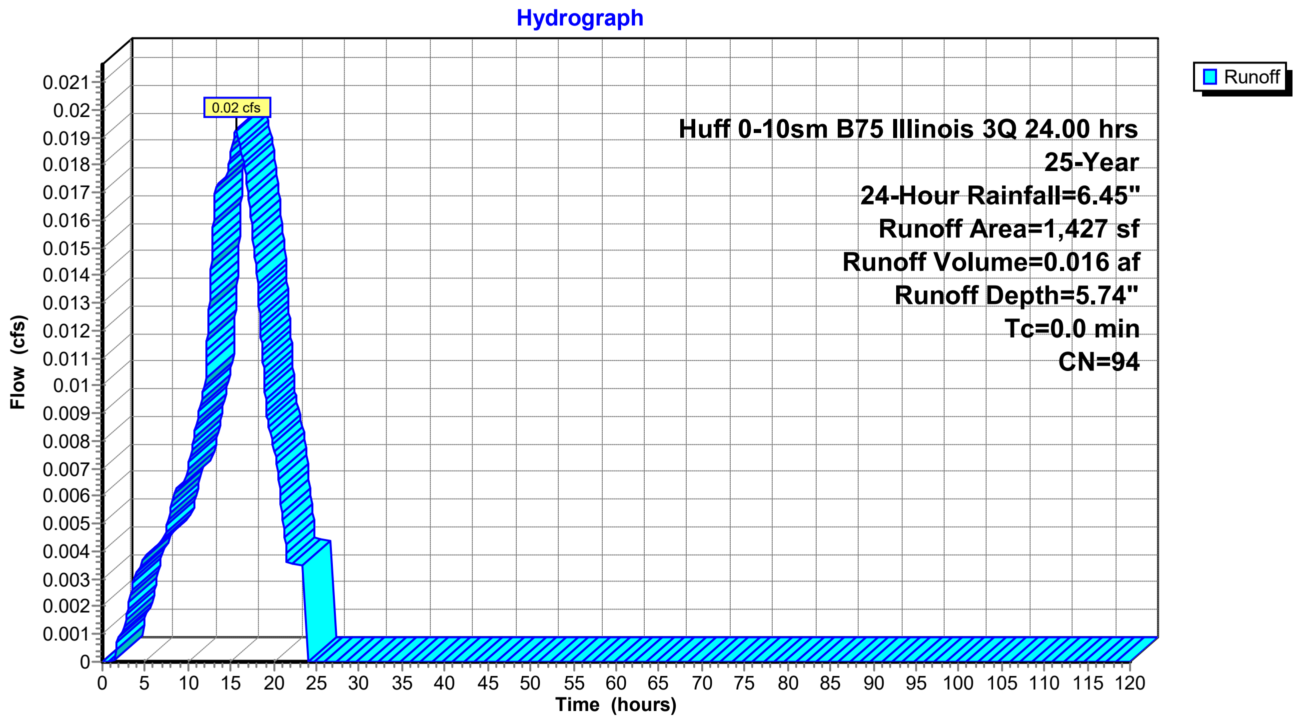
Summary for Subcatchment SC-DC-E: Direct Precip (DC-E)

Runoff = 0.02 cfs @ 15.60 hrs, Volume= 0.016 af, Depth= 5.74"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Huff 0-10sm B75 Illinois 3Q 24.00 hrs 25-Year, 24-Hour Rainfall=6.45"

Area (sf)	CN	Description
1,427	94	Newly graded area, HSG D
1,427		100.00% Pervious Area

Subcatchment SC-DC-E: Direct Precip (DC-E)



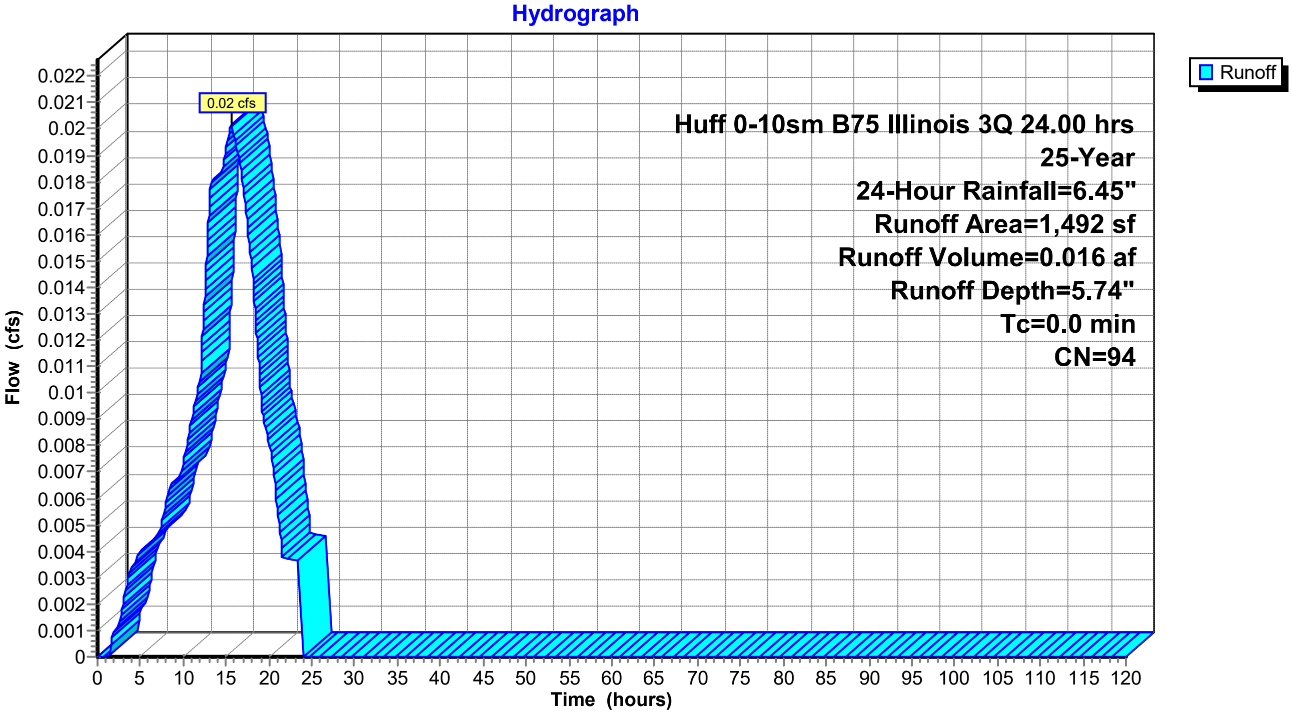
Summary for Subcatchment SC-DC-W: Direct Precip (DC-W)

Runoff = 0.02 cfs @ 15.60 hrs, Volume= 0.016 af, Depth= 5.74"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Huff 0-10sm B75 Illinois 3Q 24.00 hrs 25-Year, 24-Hour Rainfall=6.45"

Area (sf)	CN	Description
1,492	94	Newly graded area, HSG D
1,492		100.00% Pervious Area

Subcatchment SC-DC-W: Direct Precip (DC-W)



Summary for Subcatchment SC-TB-E: Subcat E Terrace

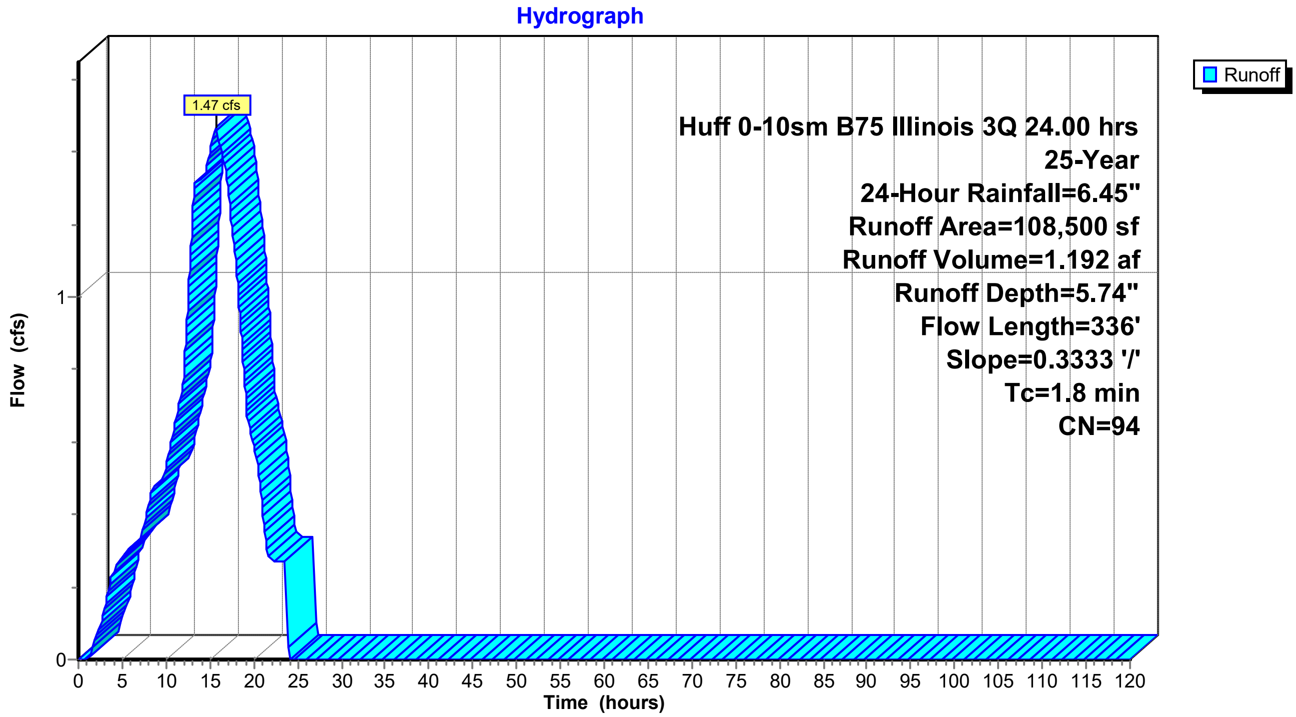
Runoff = 1.47 cfs @ 15.63 hrs, Volume= 1.192 af, Depth= 5.74"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Huff 0-10sm B75 Illinois 3Q 24.00 hrs 25-Year, 24-Hour Rainfall=6.45"

Area (sf)	CN	Description
108,500	94	Newly graded area, HSG D
108,500		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.4	100	0.3333	1.18		**Sheet Flow,** Fallow n= 0.050 P2= 2.80"
0.4	236	0.3333	9.29		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
1.8	336	Total			

Subcatchment SC-TB-E: Subcat E Terrace



Summary for Subcatchment SC-TB-W: Subcat W Terrace

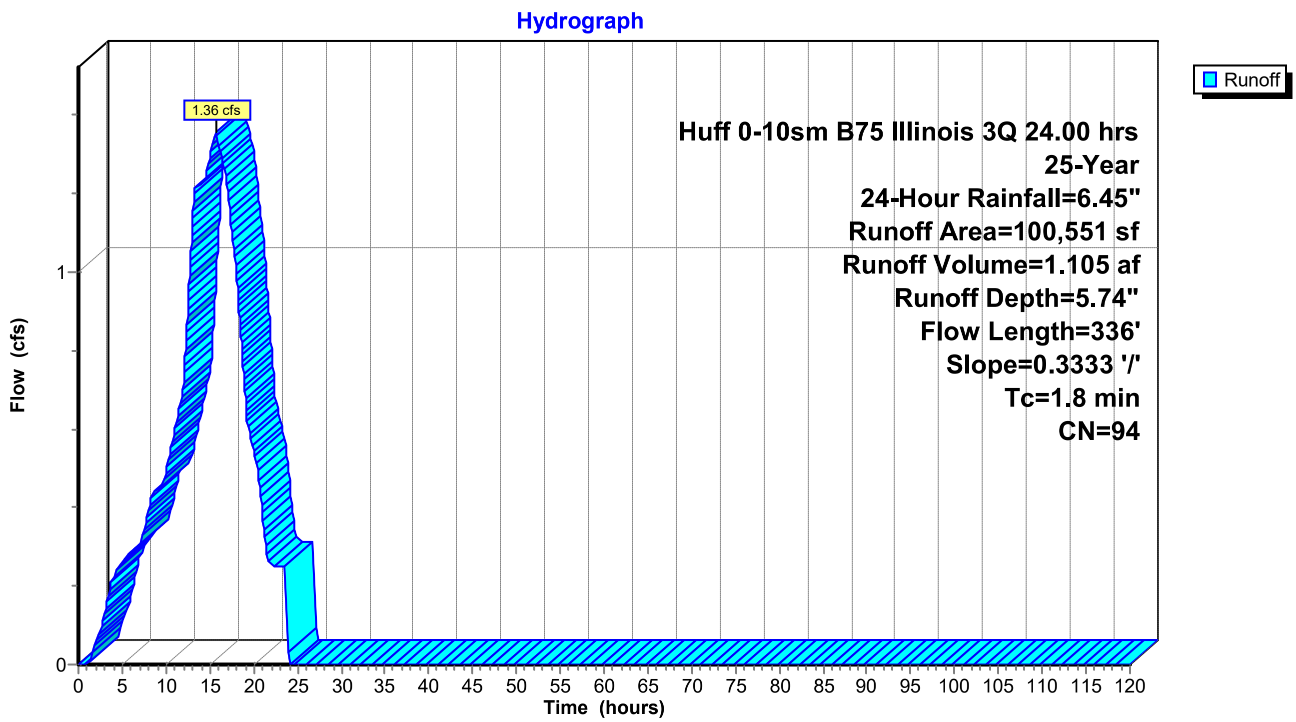
Runoff = 1.36 cfs @ 15.63 hrs, Volume= 1.105 af, Depth= 5.74"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Huff 0-10sm B75 Illinois 3Q 24.00 hrs 25-Year, 24-Hour Rainfall=6.45"

Area (sf)	CN	Description
100,551	94	Newly graded area, HSG D
100,551		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.4	100	0.3333	1.18		**Sheet Flow,** Fallow n= 0.050 P2= 2.80"
0.4	236	0.3333	9.29		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
1.8	336	Total			

Subcatchment SC-TB-W: Subcat W Terrace



Summary for Reach DC-E: East Downchute

Inflow Area = 2.52 ac, 0.00% Impervious, Inflow Depth = 5.74" for 25-Year, 24-Hour event
Inflow = 1.48 cfs @ 15.74 hrs, Volume= 1.208 af
Outflow = 1.48 cfs @ 15.76 hrs, Volume= 1.208 af, Atten= 0%, Lag= 0.9 min

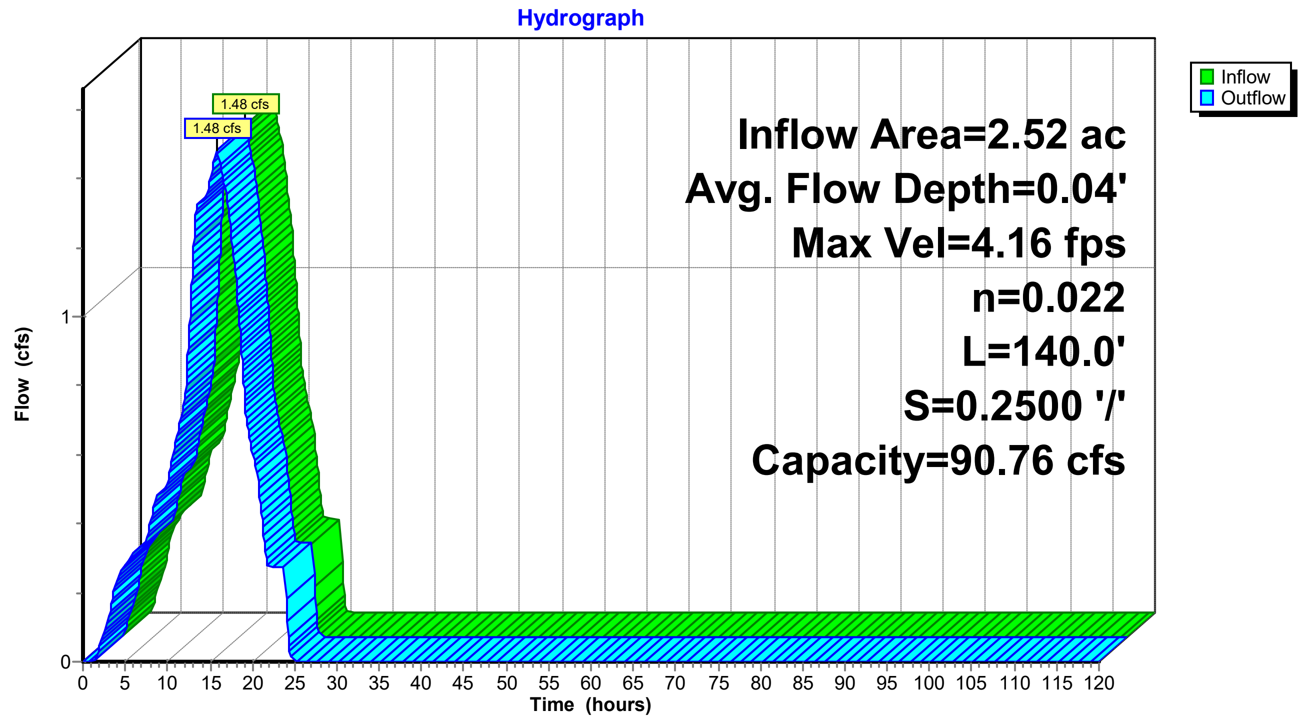
Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.16 fps, Min. Travel Time= 0.6 min
Avg. Velocity = 2.69 fps, Avg. Travel Time= 0.9 min

Peak Storage= 50 cf @ 15.75 hrs
Average Depth at Peak Storage= 0.04'
Bank-Full Depth= 0.50' Flow Area= 4.8 sf, Capacity= 90.76 cfs

8.00' x 0.50' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 3.0 '/' Top Width= 11.00'
Length= 140.0' Slope= 0.2500 '/'
Inlet Invert= 785.00', Outlet Invert= 750.00'

‡

Reach DC-E: East Downchute



Summary for Reach DC-W: West Downchute

Inflow Area = 2.34 ac, 0.00% Impervious, Inflow Depth = 5.74" for 25-Year, 24-Hour event
Inflow = 1.38 cfs @ 15.73 hrs, Volume= 1.121 af
Outflow = 1.38 cfs @ 15.75 hrs, Volume= 1.121 af, Atten= 0%, Lag= 1.0 min

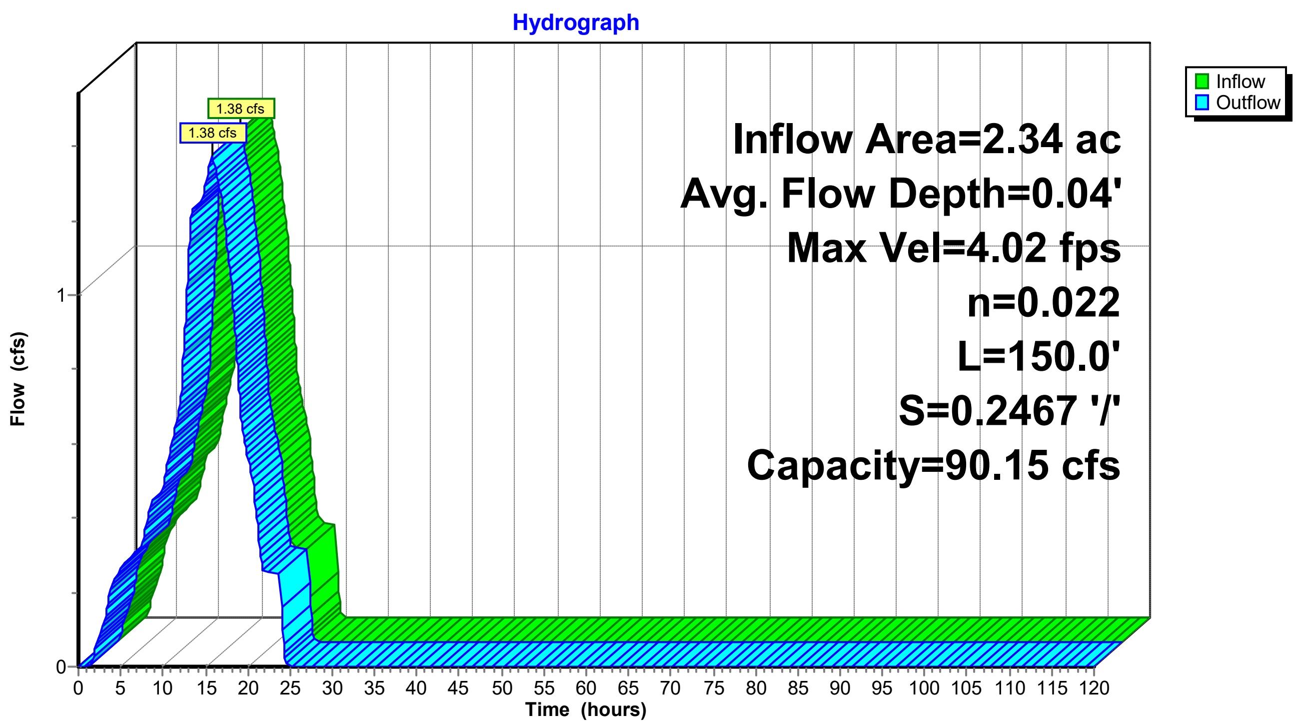
Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.02 fps, Min. Travel Time= 0.6 min
Avg. Velocity = 2.61 fps, Avg. Travel Time= 1.0 min

Peak Storage= 51 cf @ 15.74 hrs
Average Depth at Peak Storage= 0.04'
Bank-Full Depth= 0.50' Flow Area= 4.8 sf, Capacity= 90.15 cfs

8.00' x 0.50' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 3.0 '/' Top Width= 11.00'
Length= 150.0' Slope= 0.2467 '/'
Inlet Invert= 785.00', Outlet Invert= 748.00'

‡

Reach DC-W: West Downchute



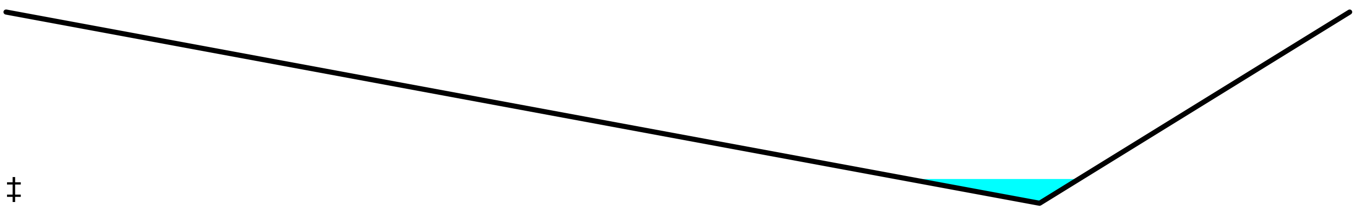
Summary for Reach TB-E: East Terrace Bench

Inflow Area = 2.49 ac, 0.00% Impervious, Inflow Depth = 5.74" for 25-Year, 24-Hour event
Inflow = 1.47 cfs @ 15.63 hrs, Volume= 1.192 af
Outflow = 1.46 cfs @ 15.74 hrs, Volume= 1.192 af, Atten= 0%, Lag= 6.6 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.25 fps, Min. Travel Time= 3.9 min
Avg. Velocity = 1.64 fps, Avg. Travel Time= 5.4 min

Peak Storage= 345 cf @ 15.68 hrs
Average Depth at Peak Storage= 0.32'
Bank-Full Depth= 2.50' Flow Area= 40.6 sf, Capacity= 362.01 cfs

0.00' x 2.50' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 10.0 3.0 '/' Top Width= 32.50'
Length= 530.0' Slope= 0.0132 '/'
Inlet Invert= 792.00', Outlet Invert= 785.00'



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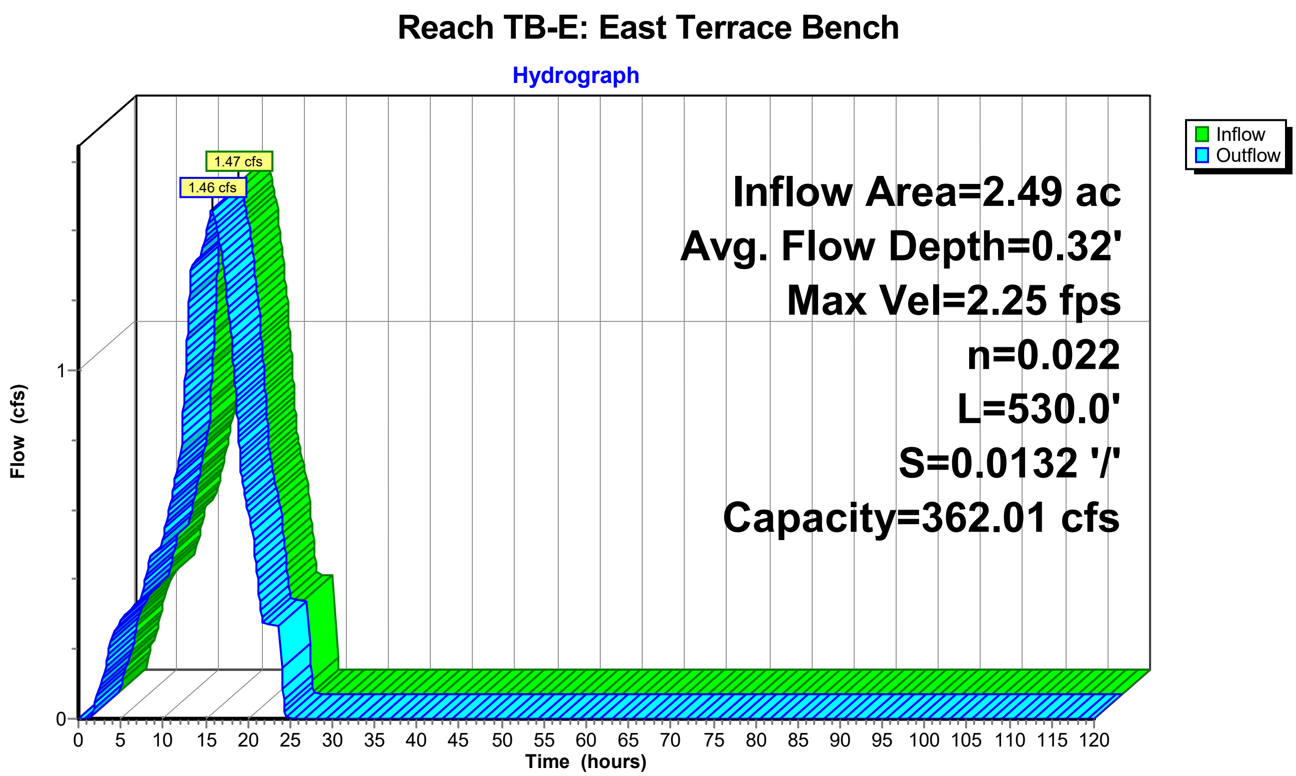


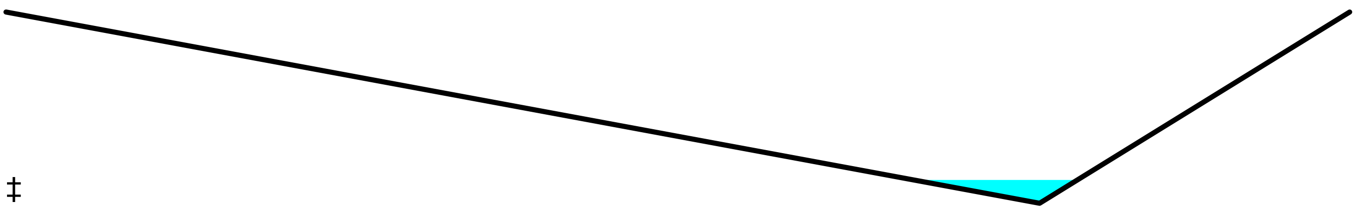
Summary for Reach TB-W: West Terrace Bench

Inflow Area = 2.31 ac, 0.00% Impervious, Inflow Depth = 5.74" for 25-Year, 24-Hour event
Inflow = 1.36 cfs @ 15.63 hrs, Volume= 1.105 af
Outflow = 1.36 cfs @ 15.73 hrs, Volume= 1.105 af, Atten= 0%, Lag= 6.1 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.26 fps, Min. Travel Time= 3.6 min
Avg. Velocity = 1.66 fps, Avg. Travel Time= 5.0 min

Peak Storage= 297 cf @ 15.67 hrs
Average Depth at Peak Storage= 0.30'
Bank-Full Depth= 2.50' Flow Area= 40.6 sf, Capacity= 374.40 cfs

0.00' x 2.50' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 10.0 3.0 '/' Top Width= 32.50'
Length= 495.5' Slope= 0.0141 '/'
Inlet Invert= 792.00', Outlet Invert= 785.00'



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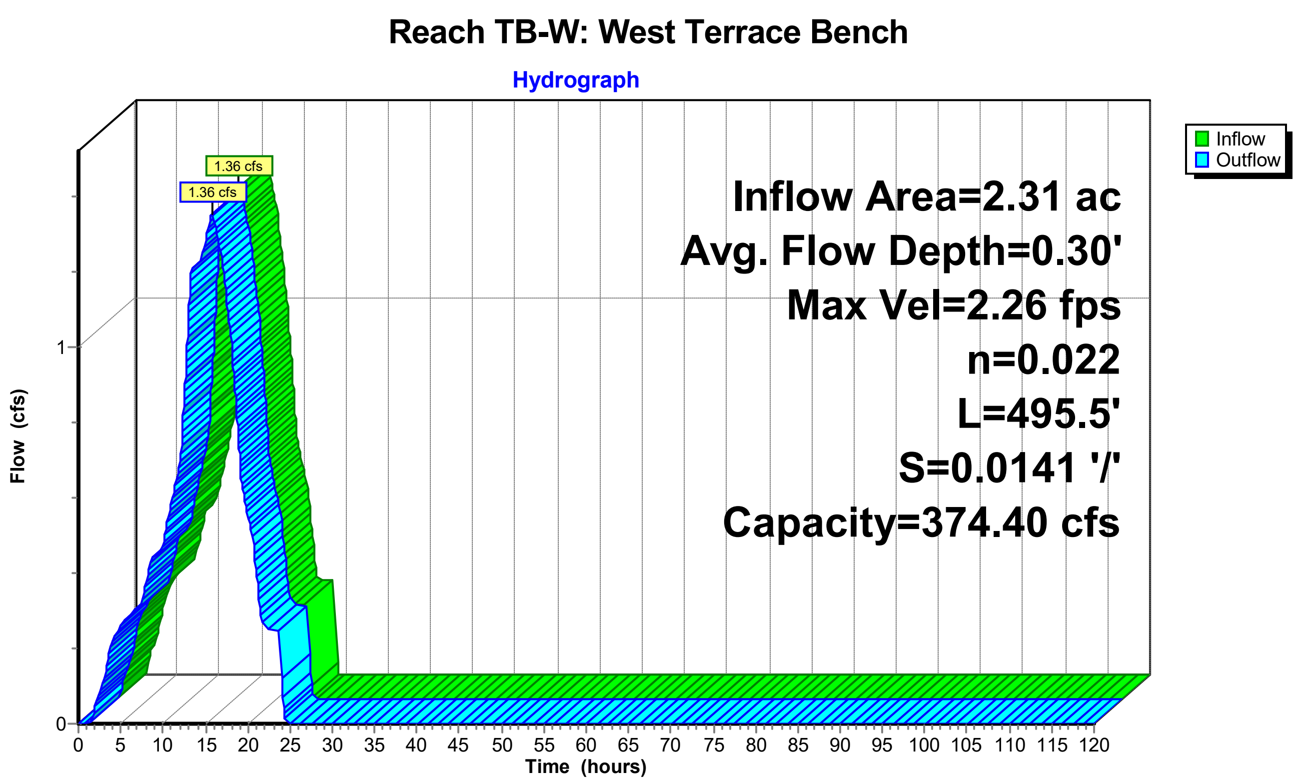
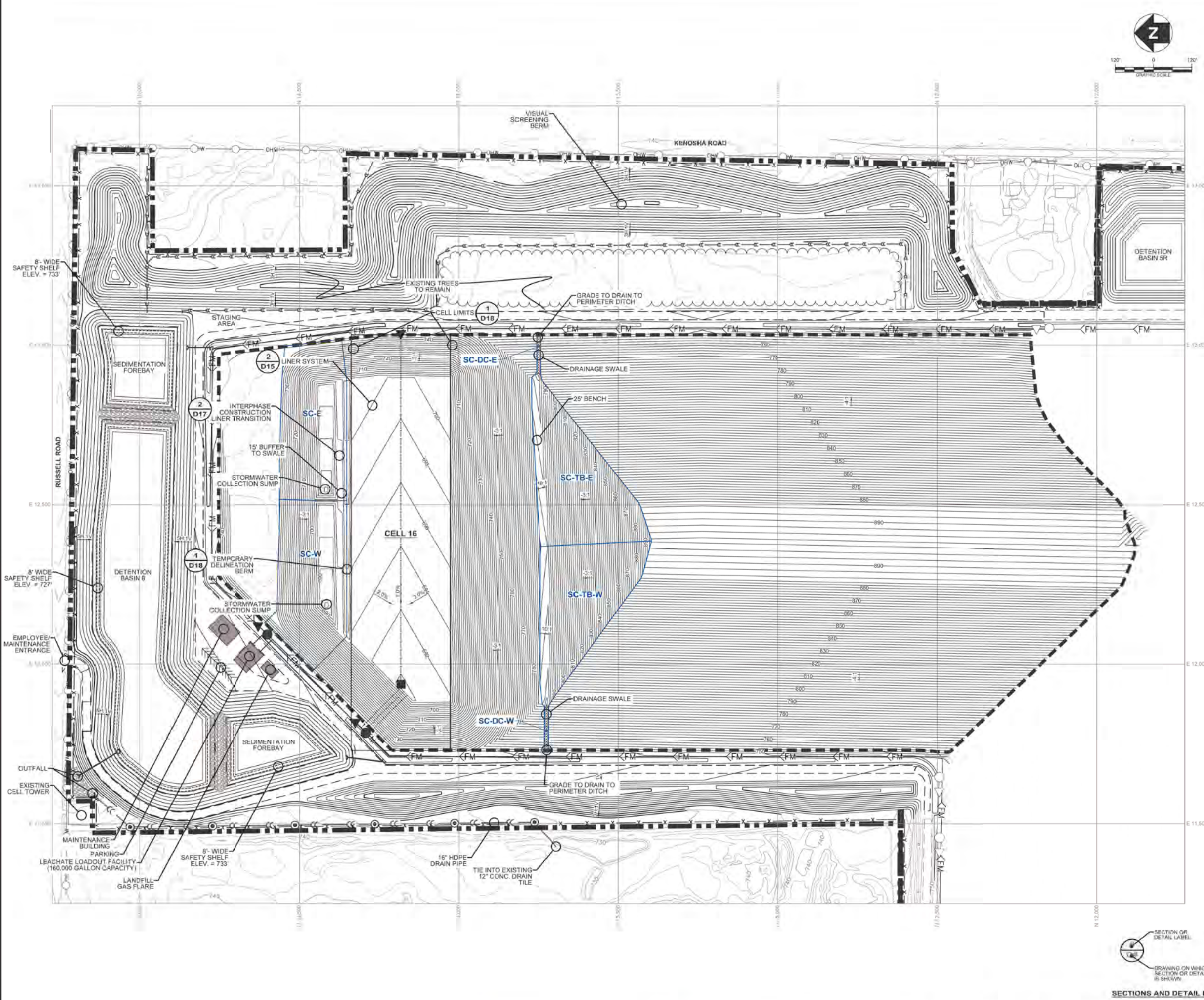
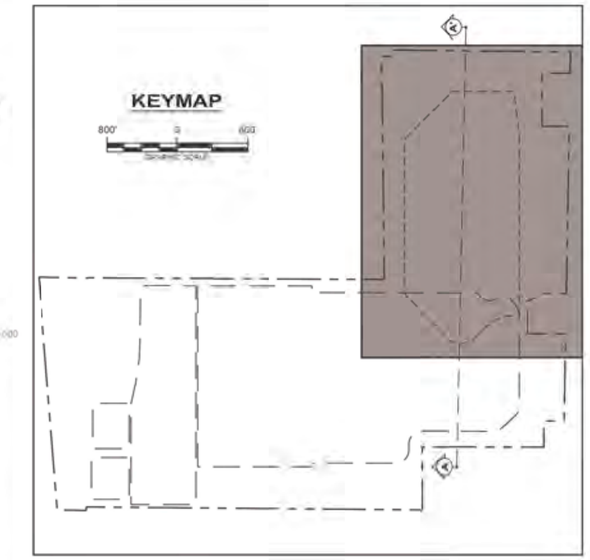


Phase F
25-year, 24-hour HydroCAD Outputs



KEYMAP



LEGEND

- APPROXIMATE FACILITY BOUNDARY
- APPROXIMATE EXISTING WASTE BOUNDARY
- APPROXIMATE PROPOSED EXPANSION WASTE BOUNDARY
- EXISTING CONTOUR
- EXISTING ROAD
- EXISTING VEGETATION
- EXISTING FENCE
- EXISTING CULVERT
- PROPOSED GROUND SURFACE ELEVATION CONTOUR (FEET-MSL)
- PROPOSED ROAD
- PROPOSED CULVERT
- EXISTING FORCEMAIN
- EXISTING LEACHATE COLLECTION PIPE
- EXISTING LEACHATE CLEANOUT LOCATION
- EXISTING LEACHATE VAULT LOCATION
- EXISTING LEACHATE COLLECTION SUMP LOCATION
- PROPOSED FORCEMAIN
- PROPOSED LEACHATE COLLECTION PIPE
- PROPOSED LEACHATE CLEANOUT LOCATION
- PROPOSED LEACHATE VAULT/MANHOLE LOCATION
- PROPOSED LEACHATE COLLECTION SUMP LOCATION
- PROPOSED DRAIN TILE
- STORMWATER MANHOLE
- STORMWATER HEADWALL
- SUBCATCHMENT BOUNDARY

NOTES

1. EXISTING CONTOURS DEVELOPED FROM SITE AERIAL TOPOGRAPHIC SURVEY BY CQM, INC. ON 10/22/2018 EXCEPT STORMWATER MANAGEMENT FEATURES ASSOCIATED WITH SITE 2 EAST (DITCHES AND BASIN 5R). STORMWATER DESIGN GRADES ARE SHOWN FOR THESE FEATURES FOR COMPLETENESS, AS NOT ALL GRADES ARE CAPTURED BY THE TOPOGRAPHIC SURVEY.
2. CURRENT TOPOGRAPHY MAY DIFFER FROM THAT SHOWN.
3. FOR CLARITY, NOT ALL SITE FEATURES MAY BE SHOWN.
4. CELL DEVELOPMENT WILL PROCEED IN NUMERICAL ORDER. VERTICAL EXPANSION WILL PROGRESS CONCURRENT WITH CELL 11 DEVELOPMENT.
5. THE TEMPORARY STORMWATER COLLECTION SUMP AND ASSOCIATED DITCH SHOWN ALONG THE NORTHERN EDGE OF THE NEWLY CONSTRUCTED CELL REPRESENTS A TYPICAL INTERIM STORMWATER MANAGEMENT SYSTEM DURING CELL CONSTRUCTION. ACTUAL INTERIM STORMWATER MANAGEMENT STRUCTURES MAY DIFFER FROM WHAT IS SHOWN BASED ON OPERATIONAL NEEDS.
6. THE TEMPORARY TERRACE BENCH AND DRAINAGE DITCH SHOWN ALONG THE OPERATIONAL SLOPE OF THE LANDFILL REPRESENTS A TYPICAL INTERIM STORMWATER MANAGEMENT FEATURE. TEMPORARY TERRACE BENCHES MAY BE USED TO COLLECT STORMWATER FROM AREAS OF THE OPERATIONAL SLOPE WHERE INTERMEDIATE COVER HAS BEEN APPLIED. INTERIM STORMWATER MANAGEMENT STRUCTURES MAY DIFFER FROM WHAT IS SHOWN BASED ON OPERATIONAL NEEDS.
7. INTERIM STORMWATER MANAGEMENT STRUCTURES MAY BE MODIFIED TO ACCOMMODATE CONSTRUCTION ACTIVITIES AS THEY PROGRESS, AND SHOULD BE APPROPRIATELY SIZED TO MANAGE STORMWATER RUNOFF DURING CONSTRUCTION.
8. THE ANTICIPATED CONSTRUCTION PHASING DEPICTED IN THIS DRAWING IS SUBJECT TO CHANGE BASED ON OPERATIONAL NEEDS.

REV. NO.	DATE	DESCRIPTION

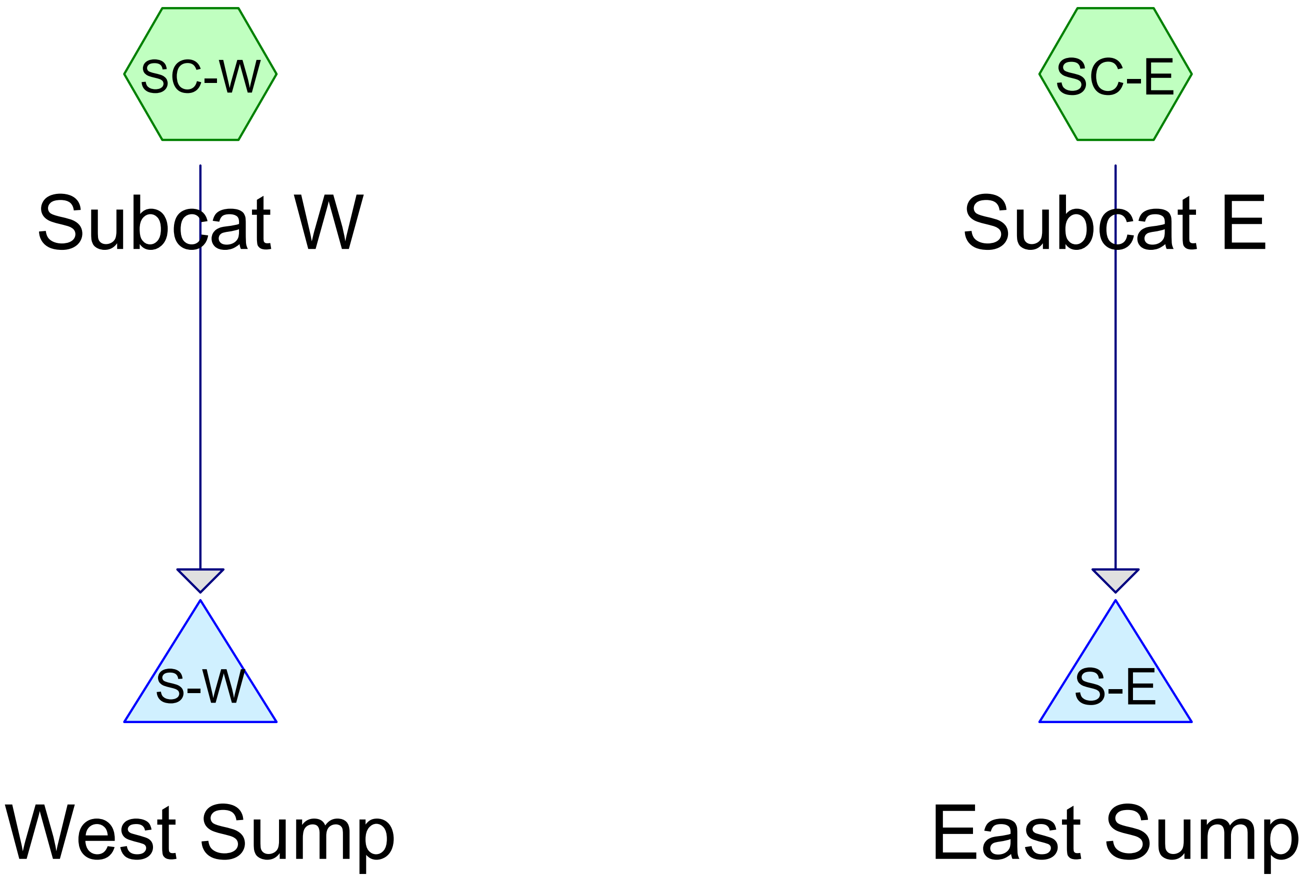
GFL GREEN FOR LIFE environmental

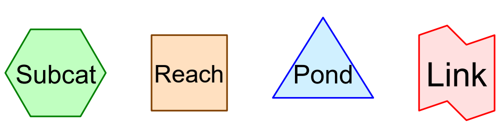
APTIM Environmental & Infrastructure, LLC

ZION LANDFILL - SITE 2 NORTH EXPANSION
CITY OF ZION, ILLINOIS

LANDFILL PHASING PLAN - PHASE F
TEMPORARY STORMWATER CONVEYANCE STRUCTURES
SUBCATCHMENT DELINEATION

PROJ. NO.:	631020105	DATE:	DECEMBER 2022
DESIGNED BY:	DAM/BWM/KM	DRAWING NO.	
DRAWN BY:	BWM/NV/KM		6
CHECKED BY:	DAM		
APPROVED BY:	DAM		6 OF 7 SHEETS





Routing Diagram for Zion Site 2 North - Phase F Temporary Sumps
Prepared by APTIM, Printed 12/14/2022
HydroCAD® 10.00-22 s/n 04891 © 2018 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
4.74	94	Newly graded area, HSG D (SC-E, SC-W)
4.74	**94**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.00	HSG A	
0.00	HSG B	
0.00	HSG C	
4.74	HSG D	SC-E, SC-W
0.00	Other	
4.74		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.00	0.00	0.00	4.74	0.00	4.74	Newly graded area	SC-E, SC-W
0.00	**0.00**	**0.00**	**4.74**	**0.00**	**4.74**	**TOTAL AREA**	

Time span=0.00-120.00 hrs, dt=0.05 hrs, 2401 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment SC-E: Subcat E Runoff Area=101,149 sf 0.00% Impervious Runoff Depth=5.74"
Tc=0.0 min CN=94 Runoff=1.37 cfs 1.111 af

Subcatchment SC-W: Subcat W Runoff Area=105,230 sf 0.00% Impervious Runoff Depth=5.74"
Tc=0.0 min CN=94 Runoff=1.42 cfs 1.156 af

Pond S-E: East Sump Peak Elev=696.83' Storage=48,402 cf Inflow=1.37 cfs 1.111 af
Outflow=0.00 cfs 0.000 af

Pond S-W: West Sump Peak Elev=693.54' Storage=50,355 cf Inflow=1.42 cfs 1.156 af
Outflow=0.00 cfs 0.000 af

Total Runoff Area = 4.74 ac Runoff Volume = 2.267 af Average Runoff Depth = 5.74"
100.00% Pervious = 4.74 ac 0.00% Impervious = 0.00 ac

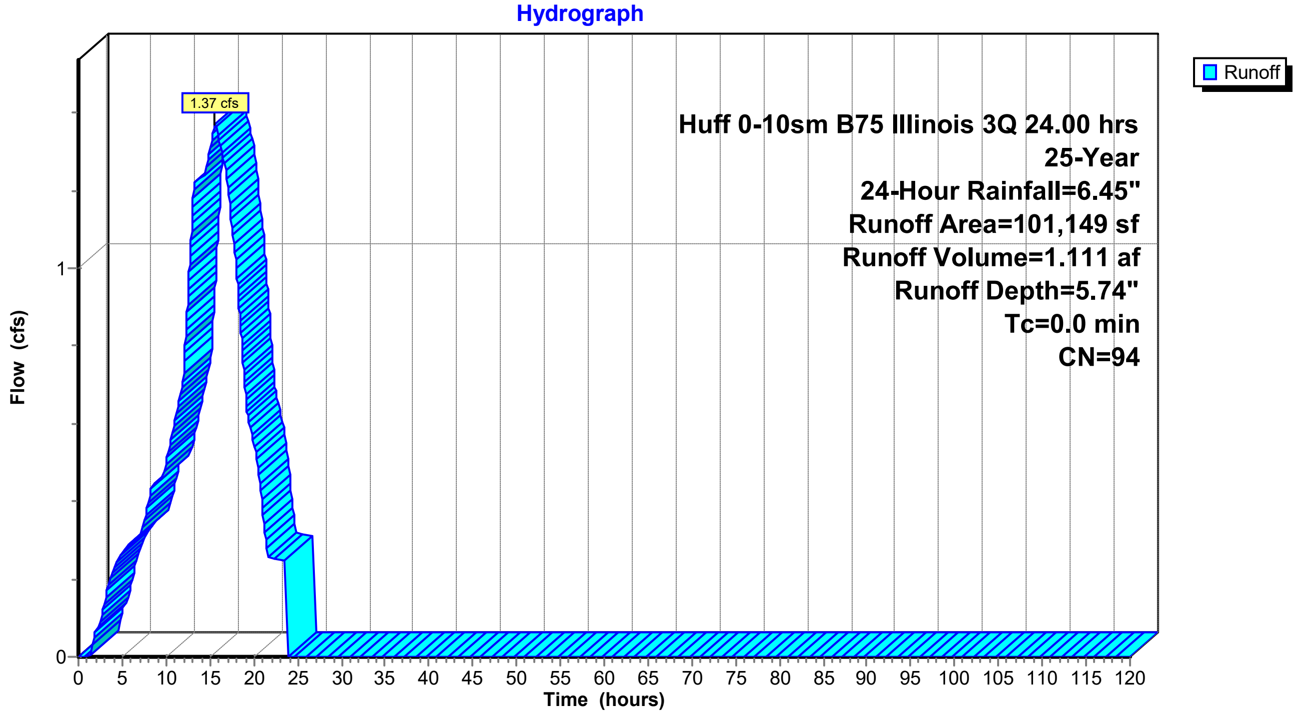
Summary for Subcatchment SC-E: Subcat E

Runoff = 1.37 cfs @ 15.60 hrs, Volume= 1.111 af, Depth= 5.74"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Huff 0-10sm B75 Illinois 3Q 24.00 hrs 25-Year, 24-Hour Rainfall=6.45"

Area (sf)	CN	Description
101,149	94	Newly graded area, HSG D
101,149		100.00% Pervious Area

Subcatchment SC-E: Subcat E



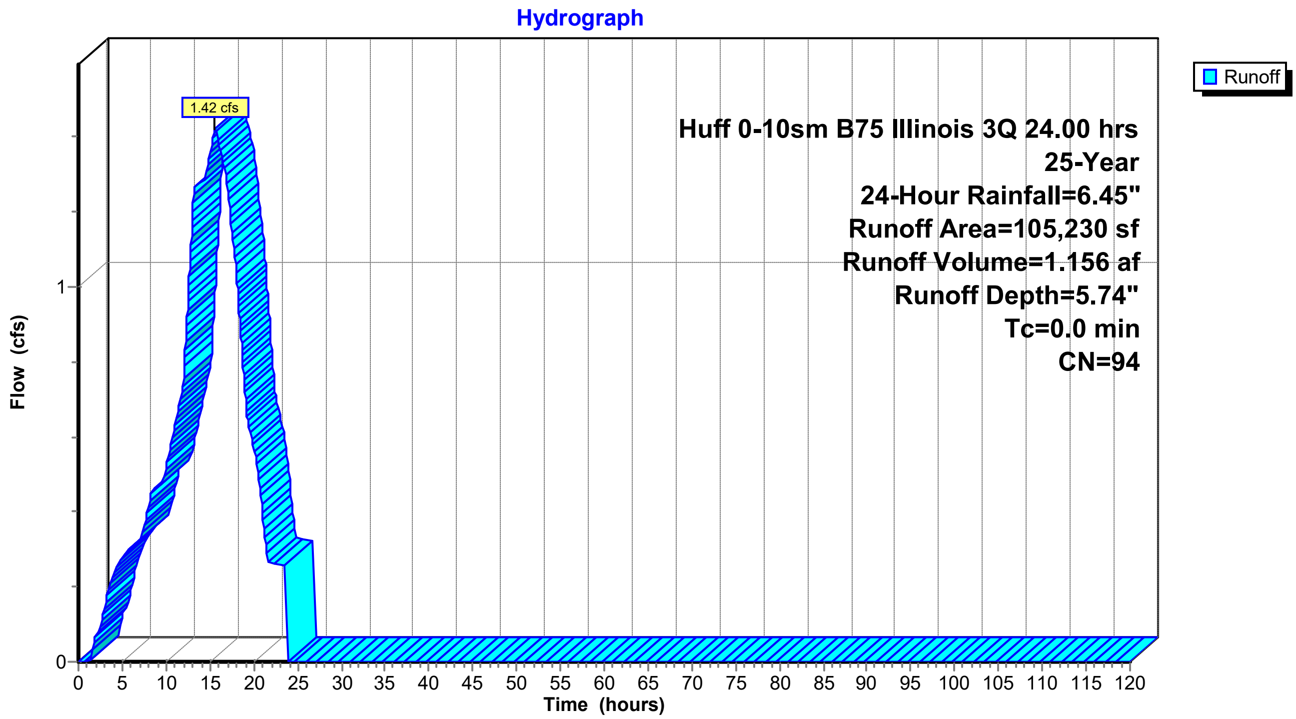
Summary for Subcatchment SC-W: Subcat W

Runoff = 1.42 cfs @ 15.60 hrs, Volume= 1.156 af, Depth= 5.74"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Huff 0-10sm B75 Illinois 3Q 24.00 hrs 25-Year, 24-Hour Rainfall=6.45"

Area (sf)	CN	Description
105,230	94	Newly graded area, HSG D
105,230		100.00% Pervious Area

Subcatchment SC-W: Subcat W



Summary for Pond S-E: East Sump

Inflow Area = 2.32 ac, 0.00% Impervious, Inflow Depth = 5.74" for 25-Year, 24-Hour event
Inflow = 1.37 cfs @ 15.60 hrs, Volume= 1.111 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min

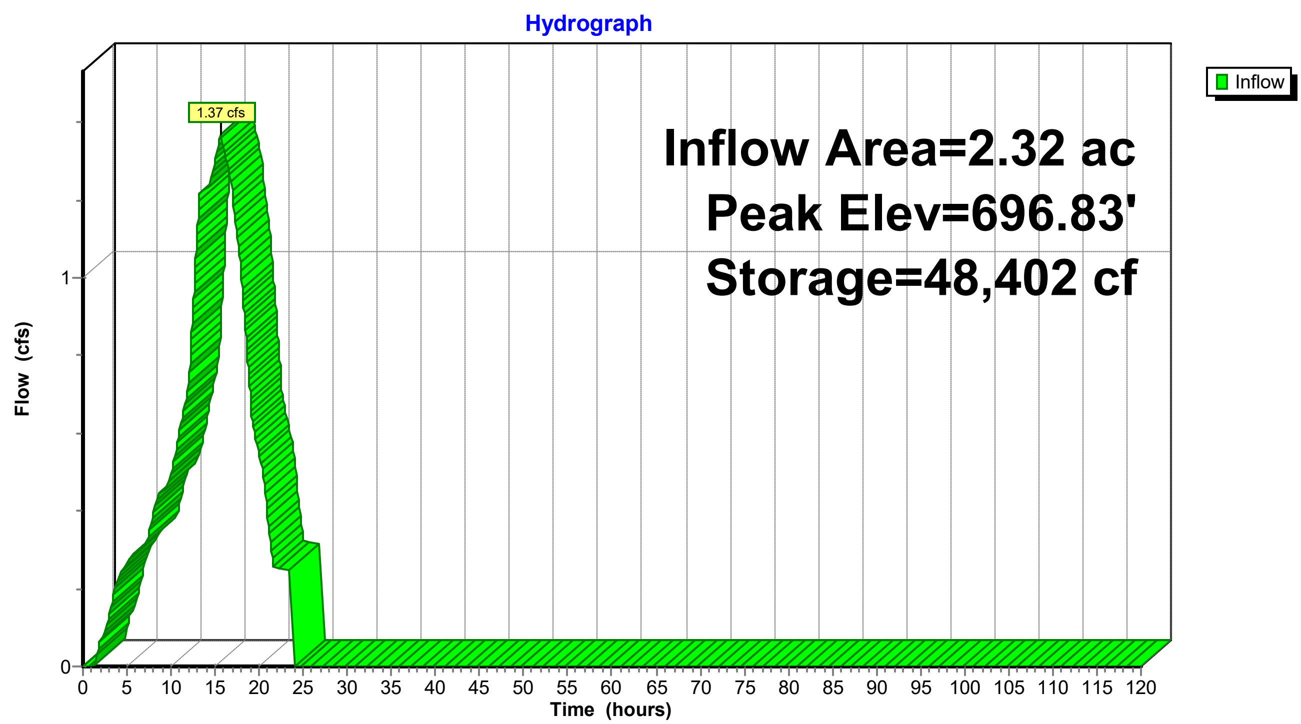
Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Peak Elev= 696.83' @ 24.05 hrs Surf.Area= 17,816 sf Storage= 48,402 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	690.00'	71,845 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
690.00	157	0	0
692.00	2,433	2,590	2,590
694.00	7,598	10,031	12,621
696.00	14,709	22,307	34,928
698.00	22,208	36,917	71,845

Pond S-E: East Sump



Summary for Pond S-W: West Sump

Inflow Area = 2.42 ac, 0.00% Impervious, Inflow Depth = 5.74" for 25-Year, 24-Hour event
Inflow = 1.42 cfs @ 15.60 hrs, Volume= 1.156 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min

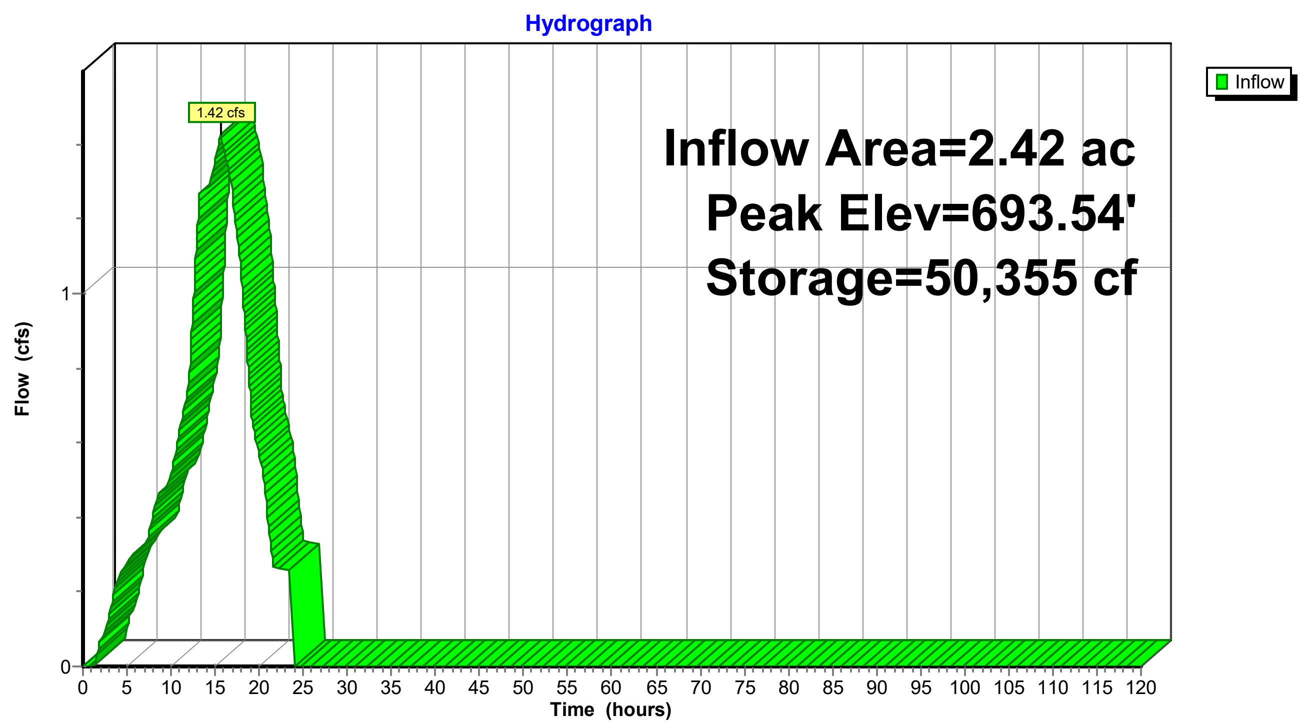
Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Peak Elev= 693.54' @ 24.05 hrs Surf.Area= 19,219 sf Storage= 50,355 cf

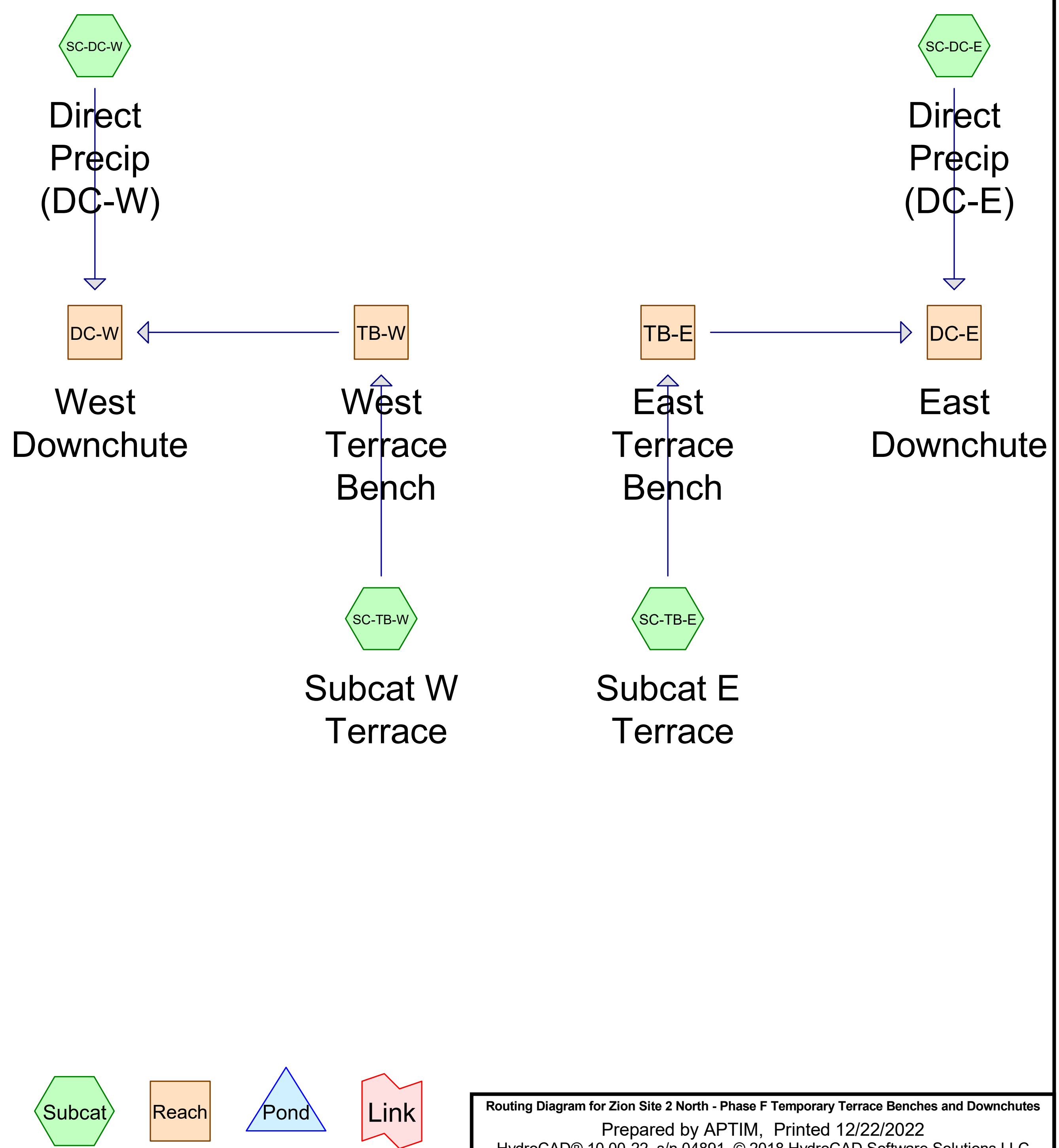
Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	686.00'	59,575 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
686.00	157	0	0
688.00	953	1,110	1,110
690.00	5,696	6,649	7,759
692.00	12,451	18,147	25,906
694.00	21,218	33,669	59,575

Pond S-W: West Sump





Routing Diagram for Zion Site 2 North - Phase F Temporary Terrace Benches and Downchutes
Prepared by APTIM, Printed 12/22/2022
HydroCAD® 10.00-22 s/n 04891 © 2018 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
5.01	94	Newly graded area, HSG D (SC-DC-E, SC-DC-W, SC-TB-E, SC-TB-W)
5.01	**94**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.00	HSG A	
0.00	HSG B	
0.00	HSG C	
5.01	HSG D	SC-DC-E, SC-DC-W, SC-TB-E, SC-TB-W
0.00	Other	
5.01		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.00	0.00	0.00	5.01	0.00	5.01	Newly graded area	SC-DC-E, SC-DC-W, SC-TB-E, SC-TB-W
0.00	**0.00**	**0.00**	**5.01**	**0.00**	**5.01**	**TOTAL AREA**	

Time span=0.00-120.00 hrs, dt=0.05 hrs, 2401 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment SC-DC-E: Direct Precip (DC-E) Runoff Area=1,268 sf 0.00% Impervious Runoff Depth=5.74"
Tc=0.0 min CN=94 Runoff=0.02 cfs 0.014 af

Subcatchment SC-DC-W: Direct Precip Runoff Area=1,482 sf 0.00% Impervious Runoff Depth=5.74"
Tc=0.0 min CN=94 Runoff=0.02 cfs 0.016 af

Subcatchment SC-TB-E: Subcat E Terrace Runoff Area=111,713 sf 0.00% Impervious Runoff Depth=5.74"
Flow Length=348' Slope=0.3333 '/' Tc=1.8 min CN=94 Runoff=1.51 cfs 1.227 af

Subcatchment SC-TB-W: Subcat W Terrace Runoff Area=103,573 sf 0.00% Impervious Runoff Depth=5.74"
Flow Length=348' Slope=0.3333 '/' Tc=1.8 min CN=94 Runoff=1.40 cfs 1.138 af

Reach DC-E: East Downchute Avg. Flow Depth=0.04' Max Vel=4.17 fps Inflow=1.53 cfs 1.241 af
n=0.022 L=127.0' S=0.2441 '/' Capacity=89.68 cfs Outflow=1.53 cfs 1.241 af

Reach DC-W: West Downchute Avg. Flow Depth=0.04' Max Vel=4.07 fps Inflow=1.42 cfs 1.154 af
n=0.022 L=150.0' S=0.2467 '/' Capacity=90.15 cfs Outflow=1.42 cfs 1.154 af

Reach TB-E: East Terrace Bench Avg. Flow Depth=0.32' Max Vel=2.25 fps Inflow=1.51 cfs 1.227 af
n=0.022 L=540.0' S=0.0130 '/' Capacity=358.64 cfs Outflow=1.51 cfs 1.227 af

Reach TB-W: West Terrace Bench Avg. Flow Depth=0.33' Max Vel=2.01 fps Inflow=1.40 cfs 1.138 af
n=0.022 L=495.0' S=0.0101 '/' Capacity=316.59 cfs Outflow=1.40 cfs 1.138 af

Total Runoff Area = 5.01 ac Runoff Volume = 2.395 af Average Runoff Depth = 5.74"
100.00% Pervious = 5.01 ac 0.00% Impervious = 0.00 ac

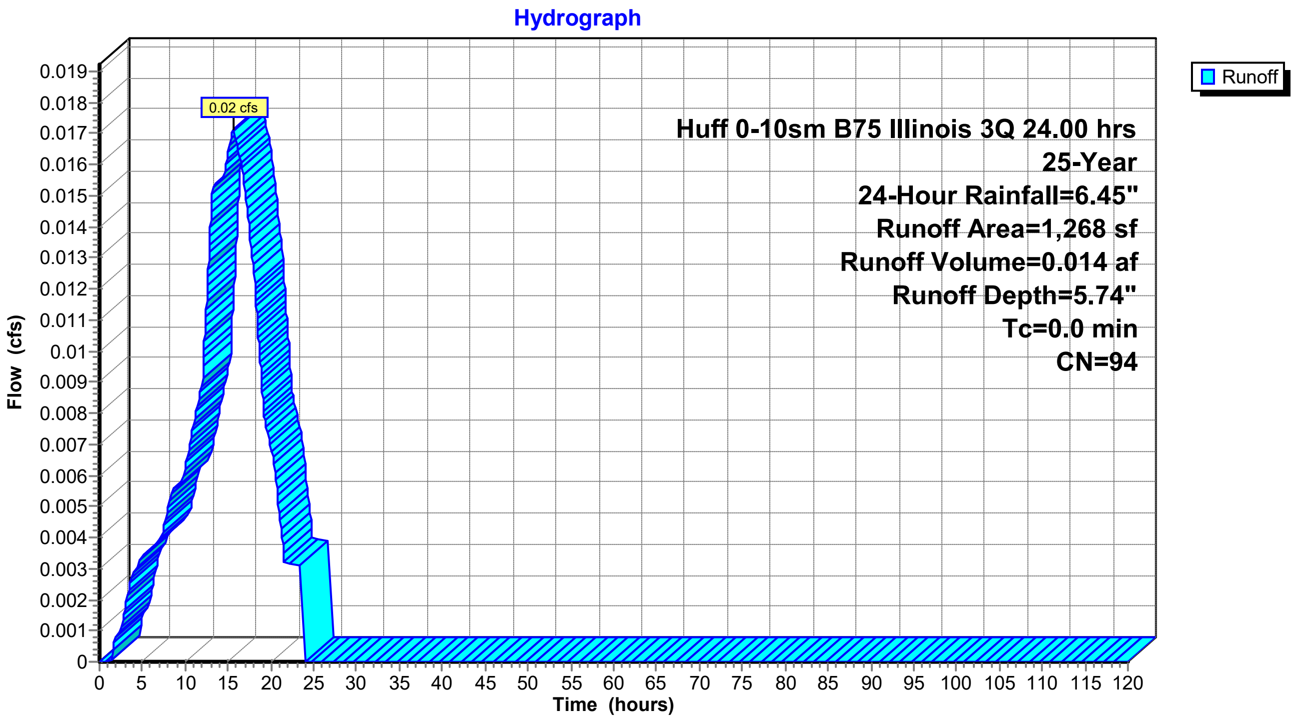
Summary for Subcatchment SC-DC-E: Direct Precip (DC-E)

Runoff = 0.02 cfs @ 15.60 hrs, Volume= 0.014 af, Depth= 5.74"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Huff 0-10sm B75 Illinois 3Q 24.00 hrs 25-Year, 24-Hour Rainfall=6.45"

Area (sf)	CN	Description
1,268	94	Newly graded area, HSG D
1,268		100.00% Pervious Area

Subcatchment SC-DC-E: Direct Precip (DC-E)



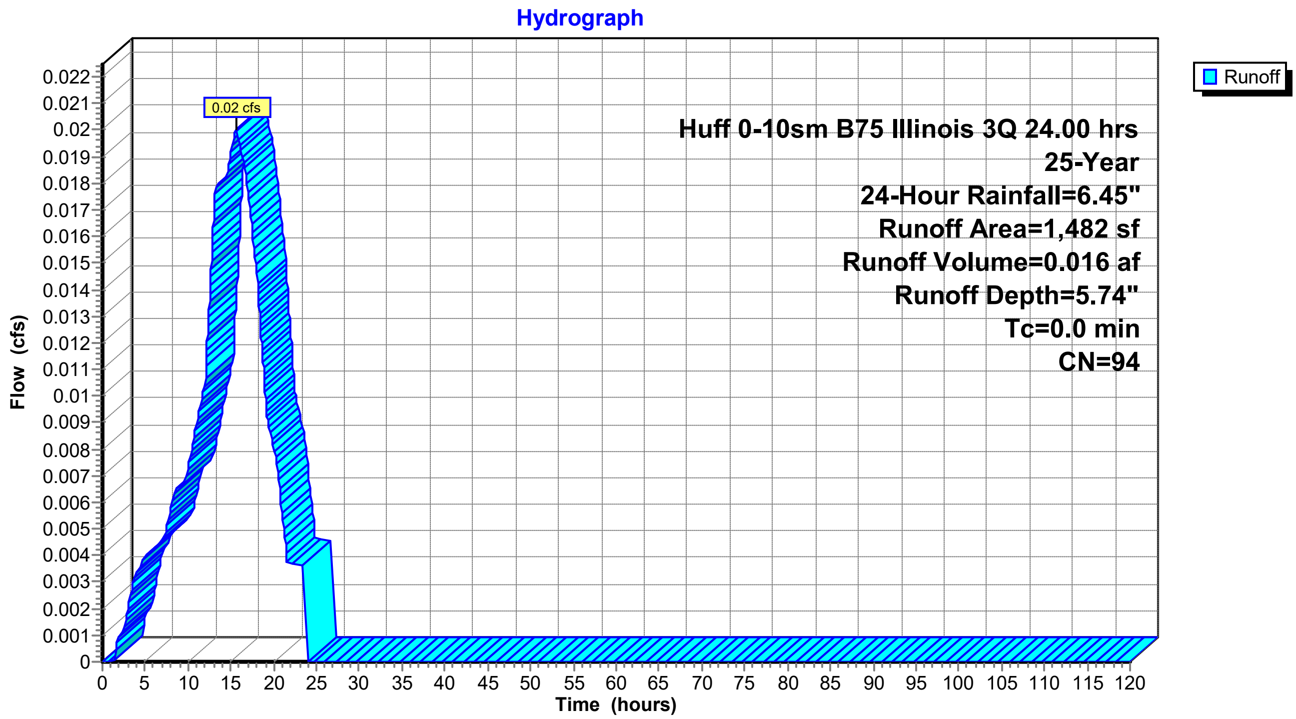
Summary for Subcatchment SC-DC-W: Direct Precip (DC-W)

Runoff = 0.02 cfs @ 15.60 hrs, Volume= 0.016 af, Depth= 5.74"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Huff 0-10sm B75 Illinois 3Q 24.00 hrs 25-Year, 24-Hour Rainfall=6.45"

Area (sf)	CN	Description
1,482	94	Newly graded area, HSG D
1,482		100.00% Pervious Area

Subcatchment SC-DC-W: Direct Precip (DC-W)



Summary for Subcatchment SC-TB-E: Subcat E Terrace

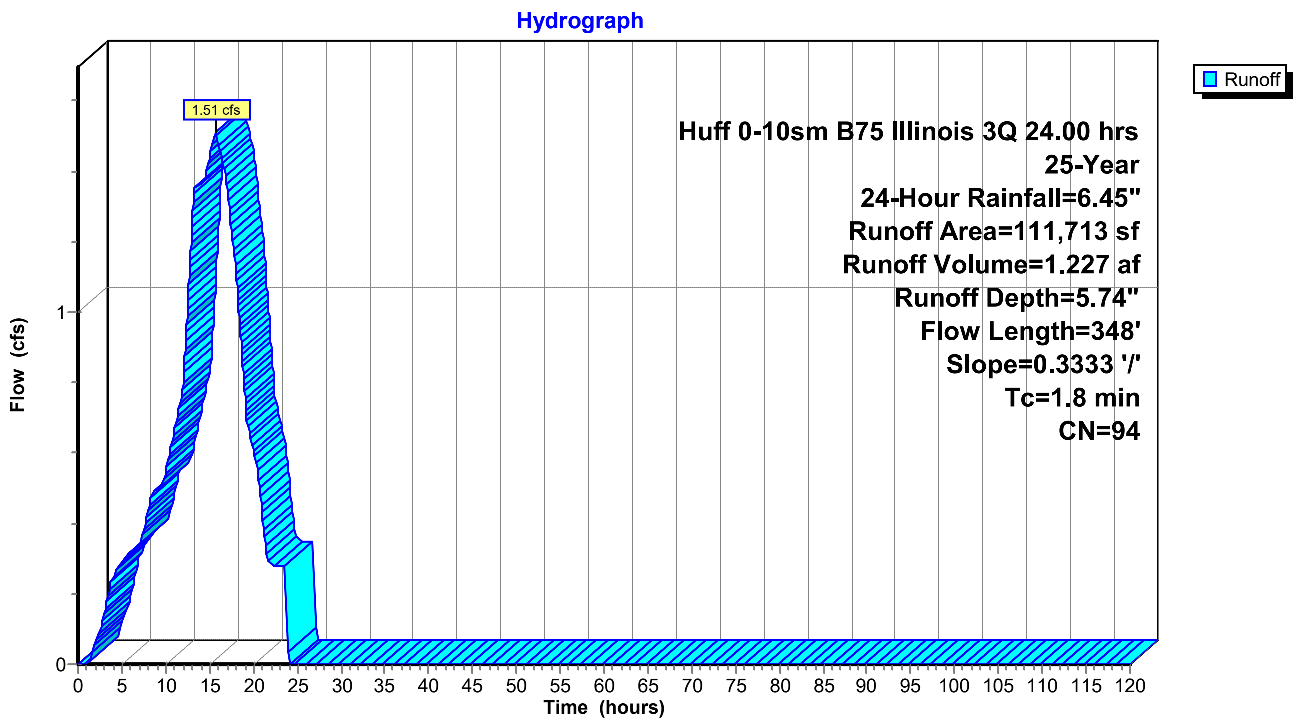
Runoff = 1.51 cfs @ 15.63 hrs, Volume= 1.227 af, Depth= 5.74"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Huff 0-10sm B75 Illinois 3Q 24.00 hrs 25-Year, 24-Hour Rainfall=6.45"

Area (sf)	CN	Description
111,713	94	Newly graded area, HSG D
111,713		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.4	100	0.3333	1.18		**Sheet Flow,** Fallow n= 0.050 P2= 2.80"
0.4	248	0.3333	9.29		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
1.8	348	Total			

Subcatchment SC-TB-E: Subcat E Terrace



Summary for Subcatchment SC-TB-W: Subcat W Terrace

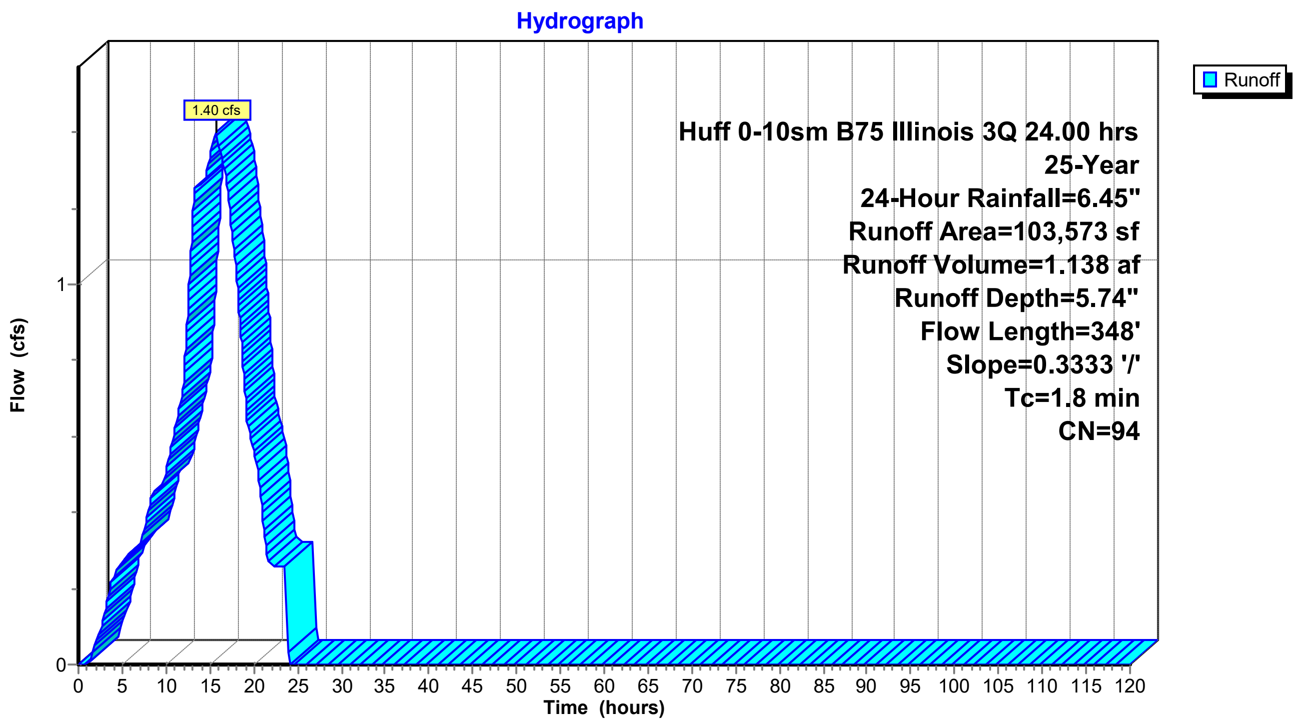
Runoff = 1.40 cfs @ 15.63 hrs, Volume= 1.138 af, Depth= 5.74"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Huff 0-10sm B75 Illinois 3Q 24.00 hrs 25-Year, 24-Hour Rainfall=6.45"

Area (sf)	CN	Description
103,573	94	Newly graded area, HSG D
103,573		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.4	100	0.3333	1.18		**Sheet Flow,** Fallow n= 0.050 P2= 2.80"
0.4	248	0.3333	9.29		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
1.8	348	Total			

Subcatchment SC-TB-W: Subcat W Terrace



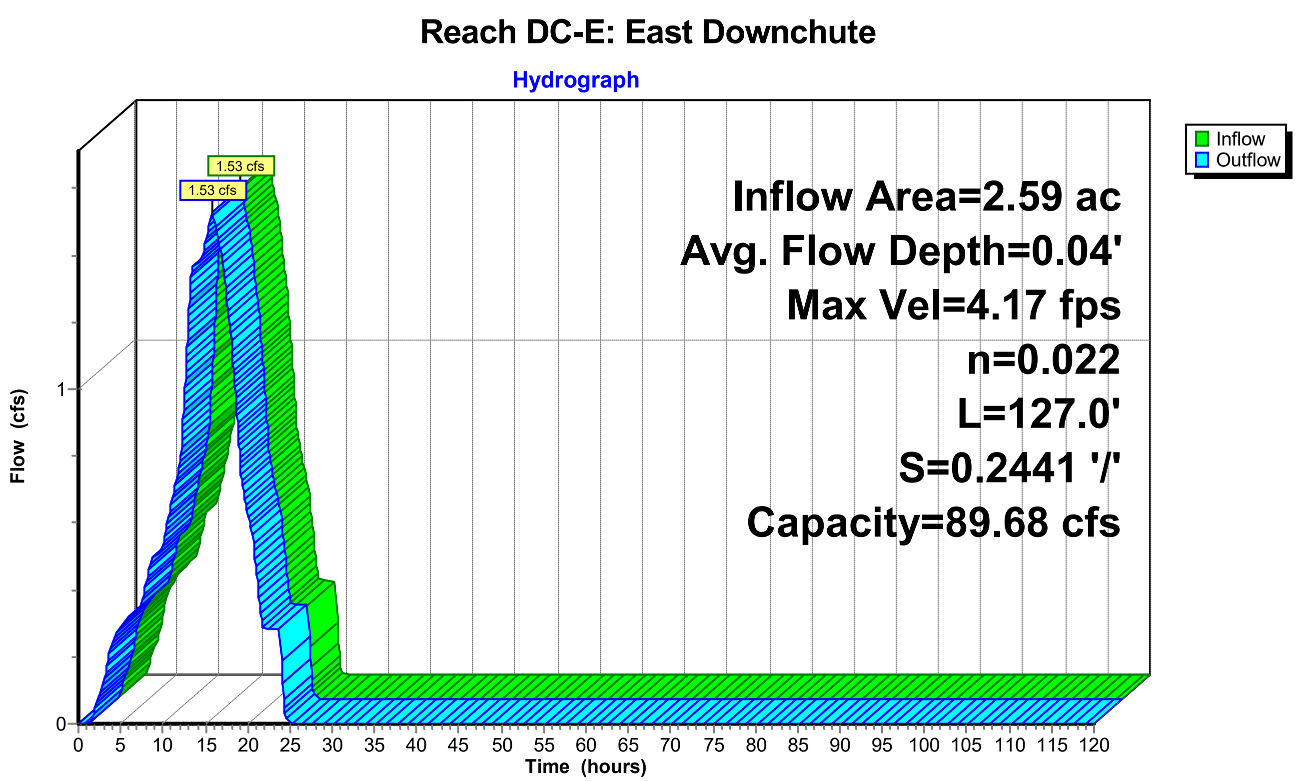
Summary for Reach DC-E: East Downchute

Inflow Area = 2.59 ac, 0.00% Impervious, Inflow Depth = 5.74" for 25-Year, 24-Hour event
Inflow = 1.53 cfs @ 15.74 hrs, Volume= 1.241 af
Outflow = 1.53 cfs @ 15.76 hrs, Volume= 1.241 af, Atten= 0%, Lag= 0.8 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.17 fps, Min. Travel Time= 0.5 min
Avg. Velocity = 2.69 fps, Avg. Travel Time= 0.8 min

Peak Storage= 46 cf @ 15.75 hrs
Average Depth at Peak Storage= 0.04'
Bank-Full Depth= 0.50' Flow Area= 4.8 sf, Capacity= 89.68 cfs

8.00' x 0.50' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 3.0 '/' Top Width= 11.00'
Length= 127.0' Slope= 0.2441 '/'
Inlet Invert= 781.00', Outlet Invert= 750.00'



Summary for Reach DC-W: West Downchute

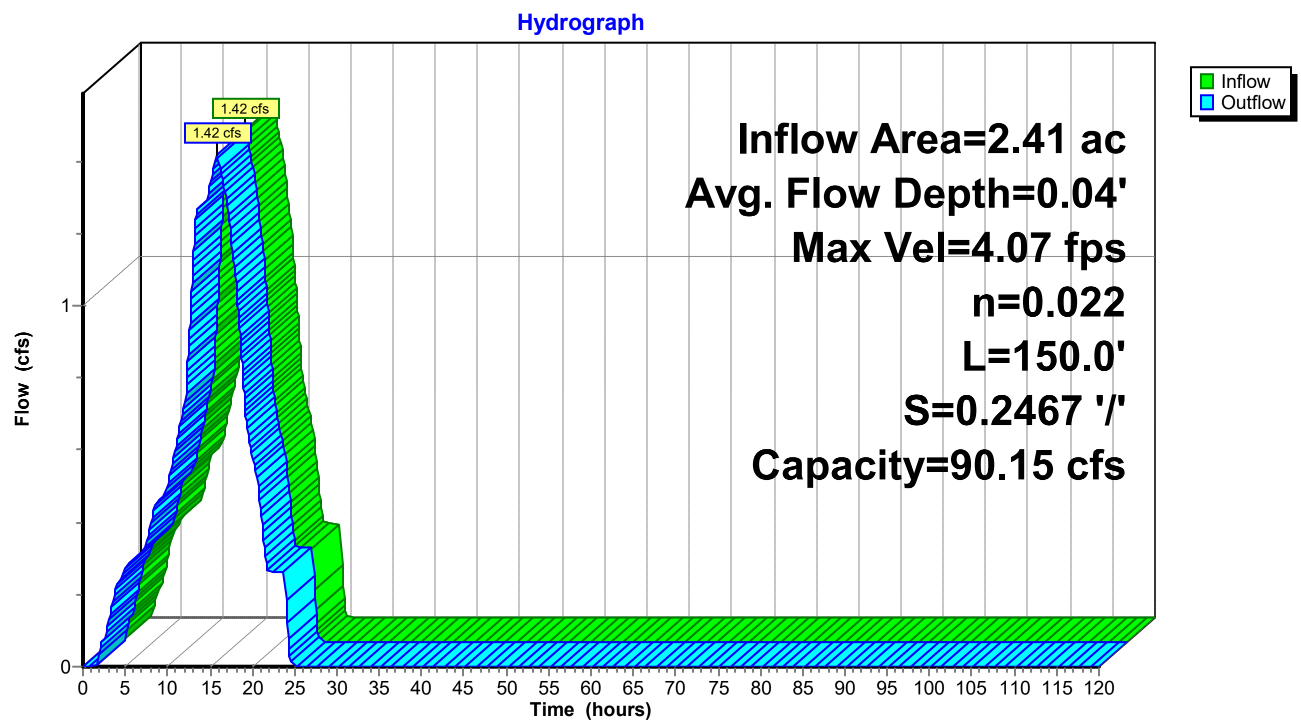
Inflow Area = 2.41 ac, 0.00% Impervious, Inflow Depth = 5.74" for 25-Year, 24-Hour event
Inflow = 1.42 cfs @ 15.75 hrs, Volume= 1.154 af
Outflow = 1.42 cfs @ 15.76 hrs, Volume= 1.154 af, Atten= 0%, Lag= 1.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.07 fps, Min. Travel Time= 0.6 min
Avg. Velocity = 2.63 fps, Avg. Travel Time= 1.0 min

Peak Storage= 52 cf @ 15.75 hrs
Average Depth at Peak Storage= 0.04'
Bank-Full Depth= 0.50' Flow Area= 4.8 sf, Capacity= 90.15 cfs

8.00' x 0.50' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 3.0 '/' Top Width= 11.00'
Length= 150.0' Slope= 0.2467 '/'
Inlet Invert= 783.00', Outlet Invert= 746.00'

Reach DC-W: West Downchute



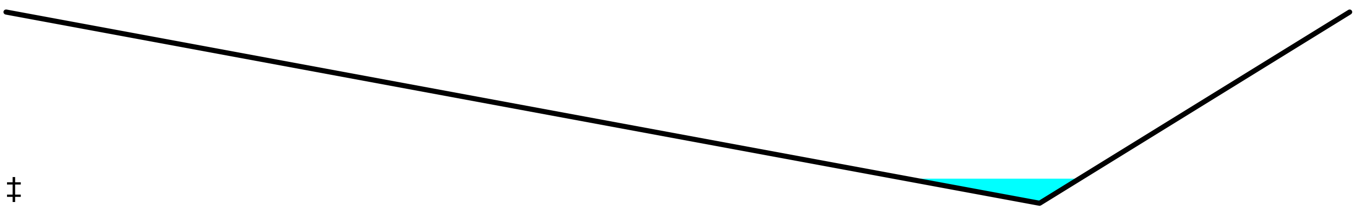
Summary for Reach TB-E: East Terrace Bench

Inflow Area = 2.56 ac, 0.00% Impervious, Inflow Depth = 5.74" for 25-Year, 24-Hour event
Inflow = 1.51 cfs @ 15.63 hrs, Volume= 1.227 af
Outflow = 1.51 cfs @ 15.75 hrs, Volume= 1.227 af, Atten= 0%, Lag= 6.8 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.25 fps, Min. Travel Time= 4.0 min
Avg. Velocity = 1.63 fps, Avg. Travel Time= 5.5 min

Peak Storage= 362 cf @ 15.68 hrs
Average Depth at Peak Storage= 0.32'
Bank-Full Depth= 2.50' Flow Area= 40.6 sf, Capacity= 358.64 cfs

0.00' x 2.50' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 10.0 3.0 '/' Top Width= 32.50'
Length= 540.0' Slope= 0.0130 '/'
Inlet Invert= 788.00', Outlet Invert= 781.00'



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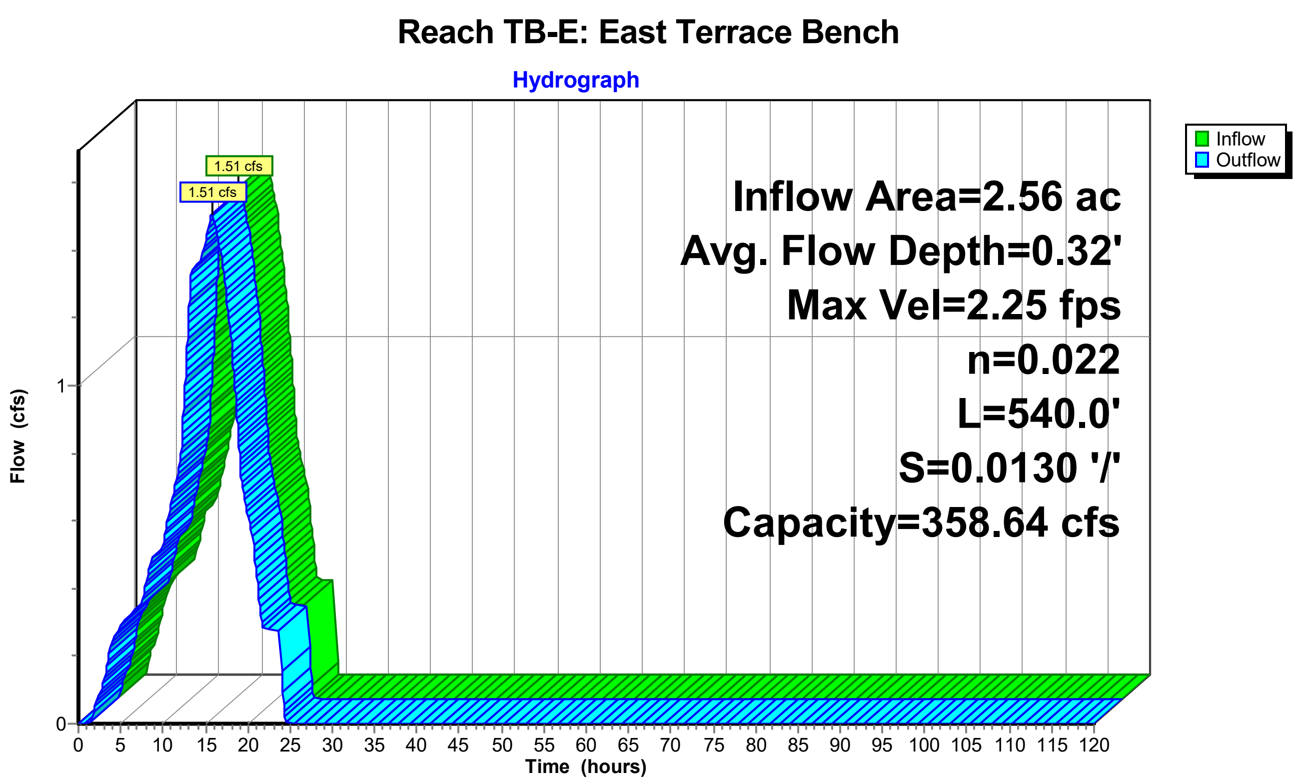


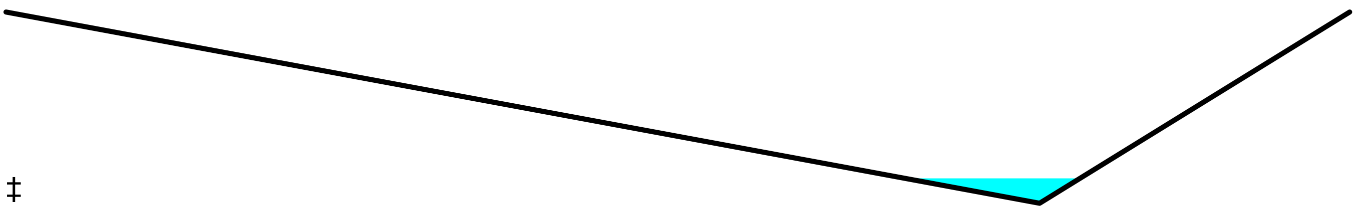
Summary for Reach TB-W: West Terrace Bench

Inflow Area = 2.38 ac, 0.00% Impervious, Inflow Depth = 5.74" for 25-Year, 24-Hour event
Inflow = 1.40 cfs @ 15.63 hrs, Volume= 1.138 af
Outflow = 1.40 cfs @ 15.75 hrs, Volume= 1.138 af, Atten= 0%, Lag= 6.9 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.01 fps, Min. Travel Time= 4.1 min
Avg. Velocity = 1.45 fps, Avg. Travel Time= 5.7 min

Peak Storage= 345 cf @ 15.68 hrs
Average Depth at Peak Storage= 0.33'
Bank-Full Depth= 2.50' Flow Area= 40.6 sf, Capacity= 316.59 cfs

0.00' x 2.50' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 10.0 3.0 '/' Top Width= 32.50'
Length= 495.0' Slope= 0.0101 '/'
Inlet Invert= 788.00', Outlet Invert= 783.00'



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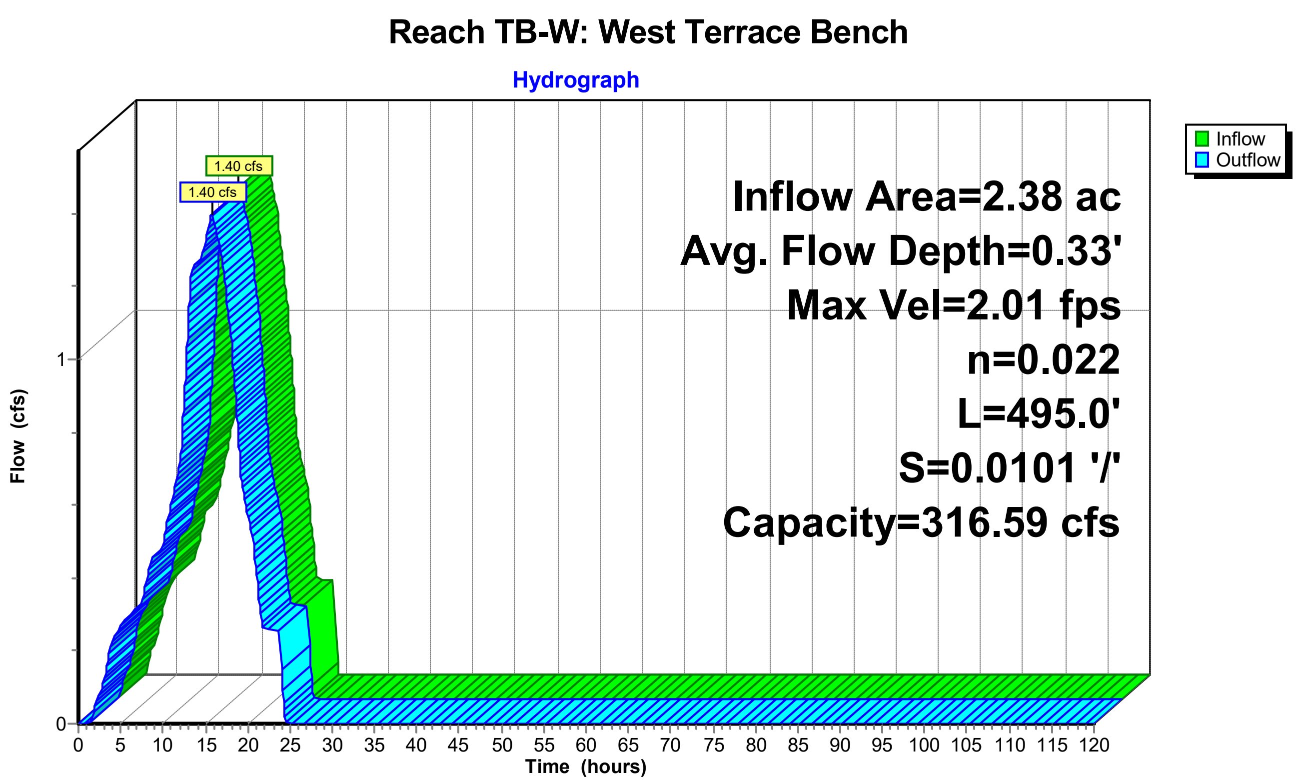
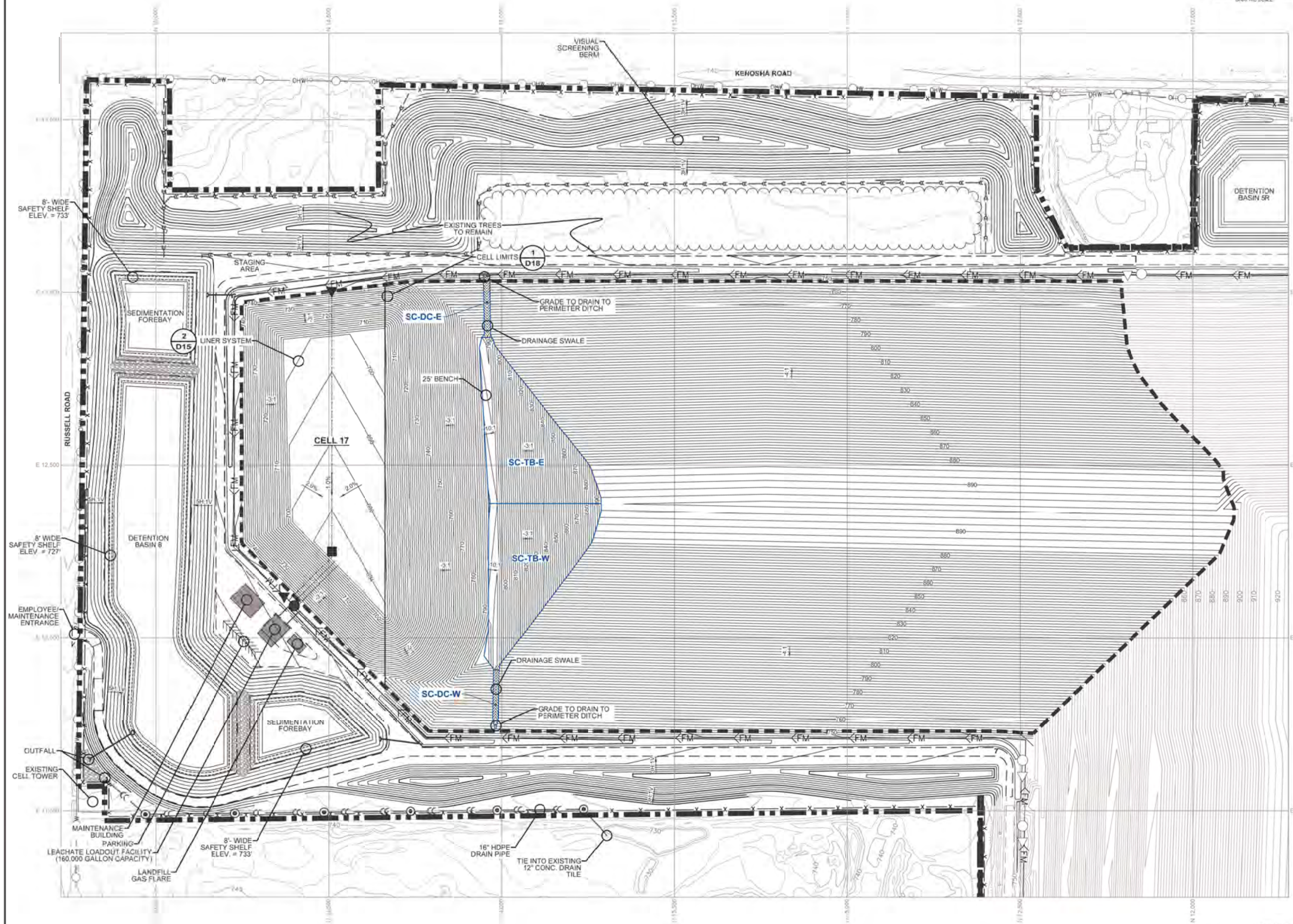
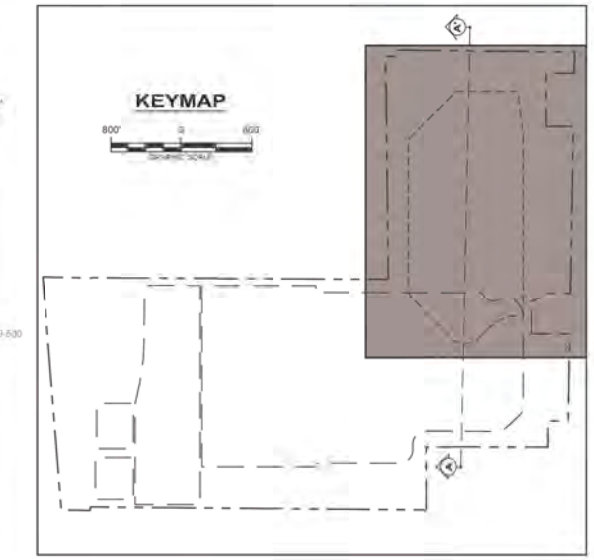


Phase G
25-year, 24-hour HydroCAD Outputs





LEGEND

- APPROXIMATE FACILITY BOUNDARY
- APPROXIMATE EXISTING WASTE BOUNDARY
- APPROXIMATE PROPOSED EXPANSION WASTE BOUNDARY
- EXISTING CONTOUR
- EXISTING ROAD
- EXISTING VEGETATION
- EXISTING FENCE
- EXISTING CULVERT
- PROPOSED GROUND SURFACE ELEVATION CONTOUR (FEET-MSL)
- PROPOSED ROAD
- PROPOSED CULVERT
- EXISTING FORCEMAIN
- EXISTING LEACHATE COLLECTION PIPE
- EXISTING LEACHATE CLEANOUT LOCATION
- EXISTING LEACHATE VAULT LOCATION
- EXISTING LEACHATE COLLECTION SUMP LOCATION
- PROPOSED FORCEMAIN
- PROPOSED LEACHATE COLLECTION PIPE
- PROPOSED LEACHATE CLEANOUT LOCATION
- PROPOSED LEACHATE VAULT/MANHOLE LOCATION
- PROPOSED LEACHATE COLLECTION SUMP LOCATION
- PROPOSED DRAIN TILE
- STORMWATER MANHOLE
- STORMWATER HEADWALL
- SUBCATCHMENT BOUNDARY

NOTES

1. EXISTING CONTOURS DEVELOPED FROM SITE AERIAL TOPOGRAPHIC SURVEY BY CQM, INC. ON 10/22/2018 EXCEPT STORMWATER MANAGEMENT FEATURES ASSOCIATED WITH SITE 2 EAST (DITCHES AND BASIN 5R). STORMWATER DESIGN GRADES ARE SHOWN FOR THESE FEATURES FOR COMPLETENESS, AS NOT ALL GRADES ARE CAPTURED BY THE TOPOGRAPHIC SURVEY.
2. CURRENT TOPOGRAPHY MAY DIFFER FROM THAT SHOWN.
3. FOR CLARITY, NOT ALL SITE FEATURES MAY BE SHOWN.
4. CELL DEVELOPMENT WILL PROCEED IN NUMERICAL ORDER. VERTICAL EXPANSION WILL PROGRESS CONCURRENT WITH CELL 11 DEVELOPMENT.
5. THE TEMPORARY STORMWATER COLLECTION SUMP AND ASSOCIATED DITCH SHOWN ALONG THE NORTHERN EDGE OF THE NEWLY CONSTRUCTED CELL REPRESENTS A TYPICAL INTERIM STORMWATER MANAGEMENT SYSTEM DURING CELL CONSTRUCTION. ACTUAL INTERIM STORMWATER MANAGEMENT STRUCTURES MAY DIFFER FROM WHAT IS SHOWN BASED ON OPERATIONAL NEEDS.
6. THE TEMPORARY TERRACE BENCH AND DRAINAGE DITCH SHOWN ALONG THE OPERATIONAL SLOPE OF THE LANDFILL REPRESENTS A TYPICAL INTERIM STORMWATER MANAGEMENT FEATURE. TEMPORARY TERRACE BENCHES MAY BE USED TO COLLECT STORMWATER FROM AREAS OF THE OPERATIONAL SLOPE WHERE INTERMEDIATE COVER HAS BEEN APPLIED. INTERIM STORMWATER MANAGEMENT STRUCTURES MAY DIFFER FROM WHAT IS SHOWN BASED ON OPERATIONAL NEEDS.
7. INTERIM STORMWATER MANAGEMENT STRUCTURES MAY BE MODIFIED TO ACCOMMODATE CONSTRUCTION ACTIVITIES AS THEY PROGRESS, AND SHOULD BE APPROPRIATELY SIZED TO MANAGE STORMWATER RUNOFF DURING CONSTRUCTION.
8. THE ANTICIPATED CONSTRUCTION PHASING DEPICTED IN THIS DRAWING IS SUBJECT TO CHANGE BASED ON OPERATIONAL NEEDS.

SECTION OR DETAIL LABEL

DRAWING ON WHICH SECTION OR DETAIL IS SHOWN

SECTIONS AND DETAIL KEY

REV. NO.	DATE	DESCRIPTION

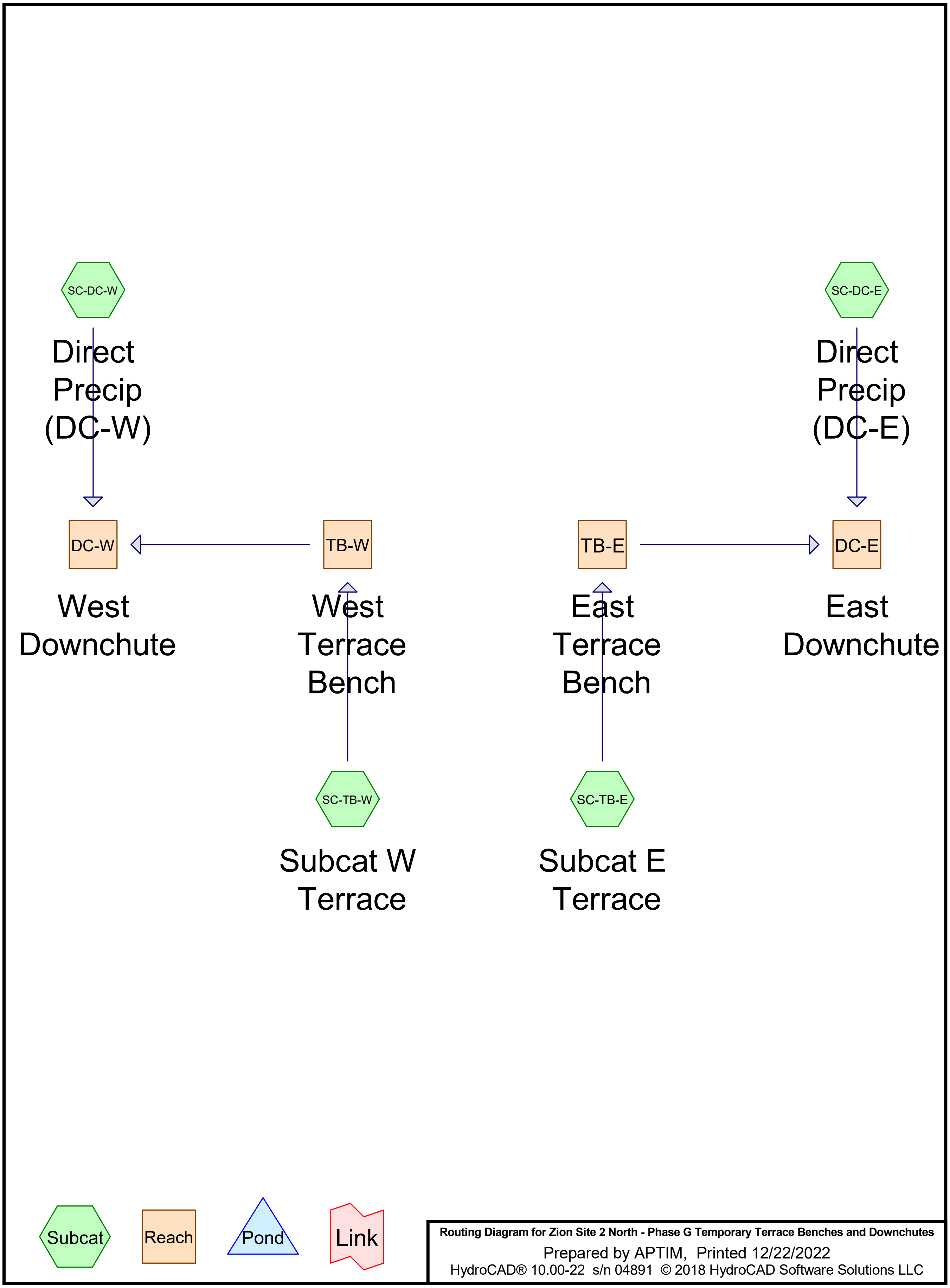
GFL GREEN FOR LIFE environmental

APTIM Environmental & Infrastructure, LLC

ZION LANDFILL - SITE 2 NORTH EXPANSION
CITY OF ZION, ILLINOIS

LANDFILL PHASING PLAN - PHASE G
TEMPORARY STORMWATER CONVEYANCE STRUCTURES SUBCATCHMENT DELINEATION

PROJ. NO.:	631020105	DATE:	DECEMBER 2022
DESIGNED BY:	DAM/BWM/KM	DRAWING NO.	
DRAWN BY:	BWM/NV/KM		7
CHECKED BY:	DAM		
APPROVED BY:	DAM		7 OF 7 SHEETS



Routing Diagram for Zion Site 2 North - Phase G Temporary Terrace Benches and Downchutes
Prepared by APTIM, Printed 12/22/2022
HydroCAD® 10.00-22 s/n 04891 © 2018 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
4.48	94	Newly graded area, HSG D (SC-DC-E, SC-DC-W, SC-TB-E, SC-TB-W)
4.48	**94**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.00	HSG A	
0.00	HSG B	
0.00	HSG C	
4.48	HSG D	SC-DC-E, SC-DC-W, SC-TB-E, SC-TB-W
0.00	Other	
4.48		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.00	0.00	0.00	4.48	0.00	4.48	Newly graded area	SC-DC-E, SC-DC-W, SC-TB-E, SC-TB-W
0.00	**0.00**	**0.00**	**4.48**	**0.00**	**4.48**	**TOTAL AREA**	

Time span=0.00-120.00 hrs, dt=0.05 hrs, 2401 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment SC-DC-E: Direct Precip (DC-E) Runoff Area=2,030 sf 0.00% Impervious Runoff Depth=5.74"
Tc=0.0 min CN=94 Runoff=0.03 cfs 0.022 af

Subcatchment SC-DC-W: Direct Precip Runoff Area=2,190 sf 0.00% Impervious Runoff Depth=5.74"
Tc=0.0 min CN=94 Runoff=0.03 cfs 0.024 af

Subcatchment SC-TB-E: Subcat E Terrace Runoff Area=95,115 sf 0.00% Impervious Runoff Depth=5.74"
Flow Length=323' Slope=0.3333 '/' Tc=1.8 min CN=94 Runoff=1.29 cfs 1.045 af

Subcatchment SC-TB-W: Subcat W Terrace Runoff Area=95,631 sf 0.00% Impervious Runoff Depth=5.74"
Flow Length=323' Slope=0.3333 '/' Tc=1.8 min CN=94 Runoff=1.29 cfs 1.051 af

Reach DC-E: East Downchute Avg. Flow Depth=0.04' Max Vel=3.94 fps Inflow=1.31 cfs 1.067 af
n=0.022 L=179.0' S=0.2458 '/' Capacity=89.99 cfs Outflow=1.31 cfs 1.067 af

Reach DC-W: West Downchute Avg. Flow Depth=0.04' Max Vel=3.94 fps Inflow=1.32 cfs 1.075 af
n=0.022 L=197.0' S=0.2437 '/' Capacity=89.60 cfs Outflow=1.32 cfs 1.075 af

Reach TB-E: East Terrace Bench Avg. Flow Depth=0.32' Max Vel=1.99 fps Inflow=1.29 cfs 1.045 af
n=0.022 L=482.0' S=0.0104 '/' Capacity=320.83 cfs Outflow=1.28 cfs 1.045 af

Reach TB-W: West Terrace Bench Avg. Flow Depth=0.33' Max Vel=1.84 fps Inflow=1.29 cfs 1.051 af
n=0.022 L=476.0' S=0.0084 '/' Capacity=288.76 cfs Outflow=1.29 cfs 1.051 af

Total Runoff Area = 4.48 ac Runoff Volume = 2.142 af Average Runoff Depth = 5.74"
100.00% Pervious = 4.48 ac 0.00% Impervious = 0.00 ac

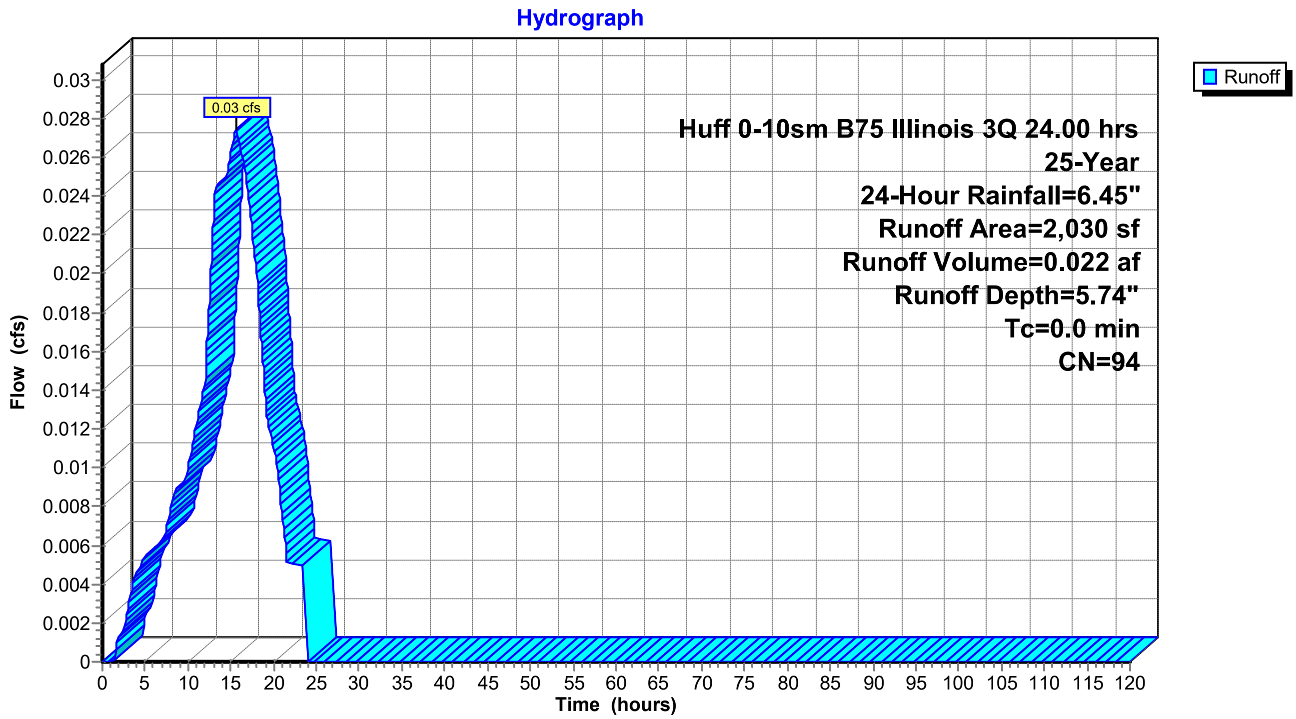
Summary for Subcatchment SC-DC-E: Direct Precip (DC-E)

Runoff = 0.03 cfs @ 15.60 hrs, Volume= 0.022 af, Depth= 5.74"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Huff 0-10sm B75 Illinois 3Q 24.00 hrs 25-Year, 24-Hour Rainfall=6.45"

Area (sf)	CN	Description
2,030	94	Newly graded area, HSG D
2,030		100.00% Pervious Area

Subcatchment SC-DC-E: Direct Precip (DC-E)



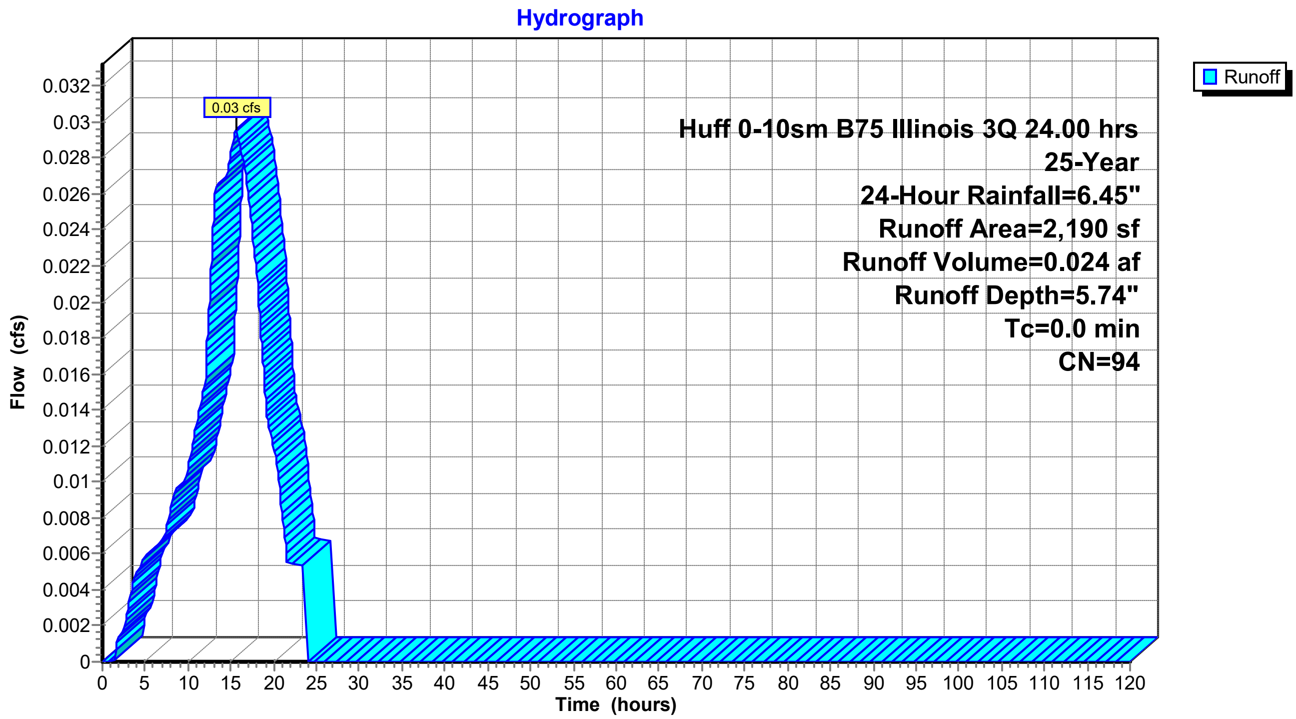
Summary for Subcatchment SC-DC-W: Direct Precip (DC-W)

Runoff = 0.03 cfs @ 15.60 hrs, Volume= 0.024 af, Depth= 5.74"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Huff 0-10sm B75 Illinois 3Q 24.00 hrs 25-Year, 24-Hour Rainfall=6.45"

Area (sf)	CN	Description
2,190	94	Newly graded area, HSG D
2,190		100.00% Pervious Area

Subcatchment SC-DC-W: Direct Precip (DC-W)



Summary for Subcatchment SC-TB-E: Subcat E Terrace

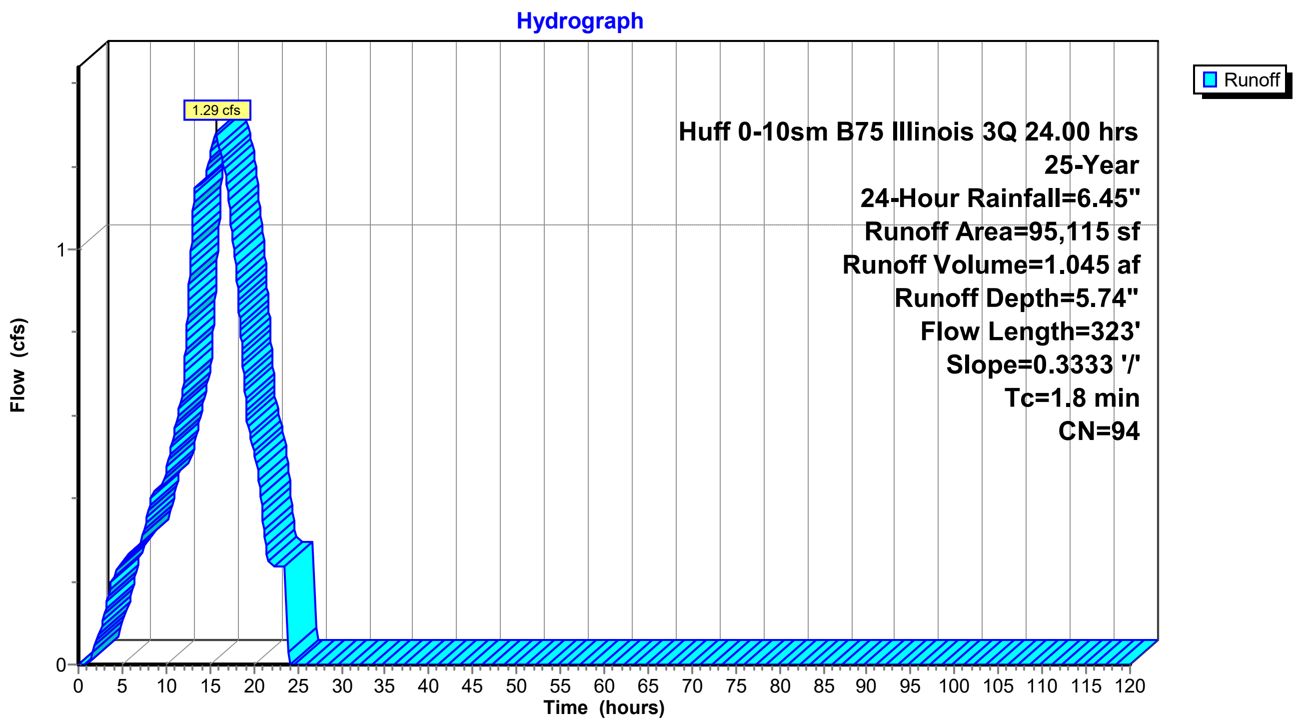
Runoff = 1.29 cfs @ 15.63 hrs, Volume= 1.045 af, Depth= 5.74"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Huff 0-10sm B75 Illinois 3Q 24.00 hrs 25-Year, 24-Hour Rainfall=6.45"

Area (sf)	CN	Description
95,115	94	Newly graded area, HSG D
95,115		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.4	100	0.3333	1.18		**Sheet Flow,** Fallow n= 0.050 P2= 2.80"
0.4	223	0.3333	9.29		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
1.8	323	Total			

Subcatchment SC-TB-E: Subcat E Terrace



Summary for Subcatchment SC-TB-W: Subcat W Terrace

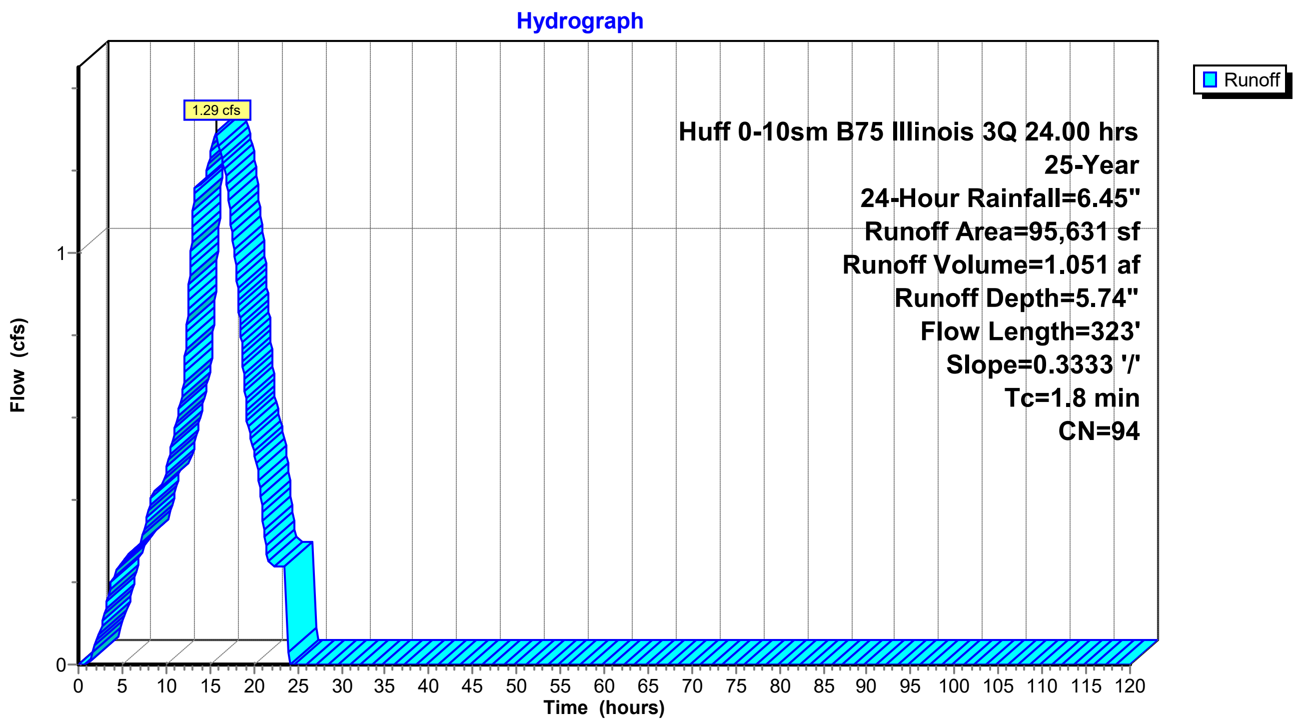
Runoff = 1.29 cfs @ 15.63 hrs, Volume= 1.051 af, Depth= 5.74"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Huff 0-10sm B75 Illinois 3Q 24.00 hrs 25-Year, 24-Hour Rainfall=6.45"

Area (sf)	CN	Description
95,631	94	Newly graded area, HSG D
95,631		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.4	100	0.3333	1.18		**Sheet Flow,** Fallow n= 0.050 P2= 2.80"
0.4	223	0.3333	9.29		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
1.8	323	Total			

Subcatchment SC-TB-W: Subcat W Terrace



Summary for Reach DC-E: East Downchute

Inflow Area = 2.23 ac, 0.00% Impervious, Inflow Depth = 5.74" for 25-Year, 24-Hour event
Inflow = 1.31 cfs @ 15.74 hrs, Volume= 1.067 af
Outflow = 1.31 cfs @ 15.76 hrs, Volume= 1.067 af, Atten= 0%, Lag= 1.2 min

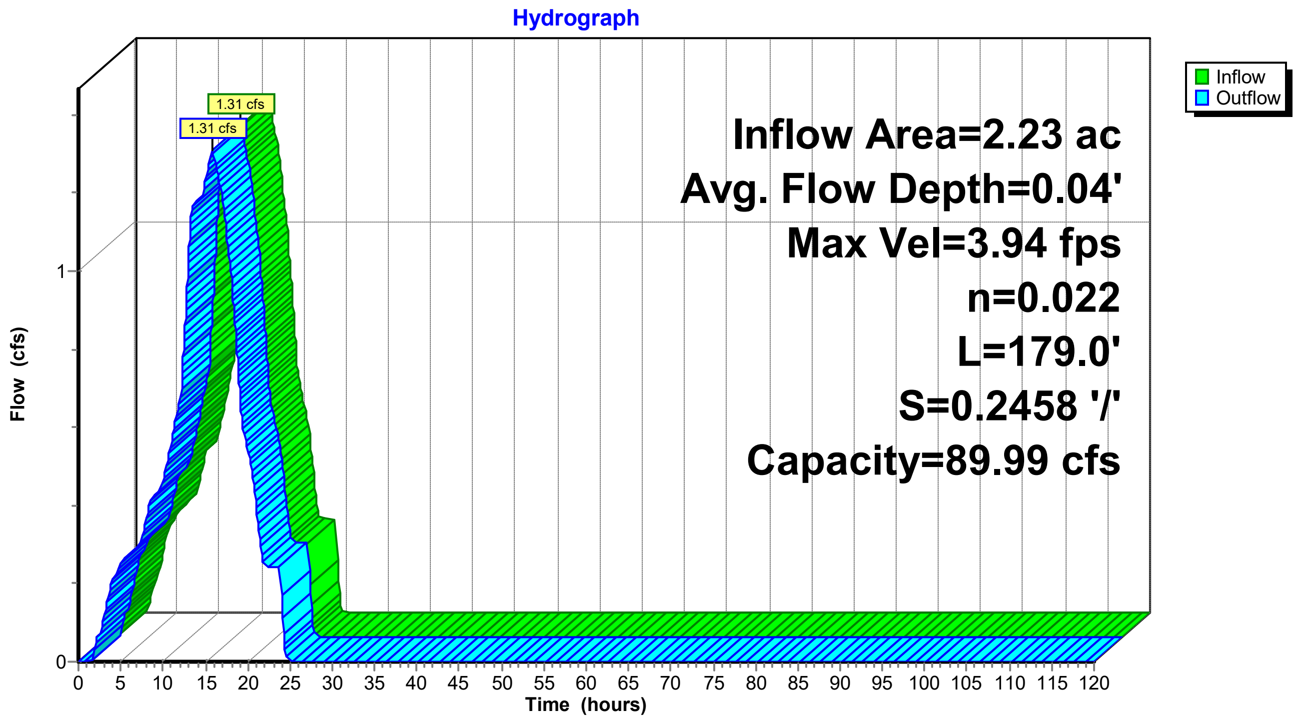
Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.94 fps, Min. Travel Time= 0.8 min
Avg. Velocity = 2.55 fps, Avg. Travel Time= 1.2 min

Peak Storage= 60 cf @ 15.75 hrs
Average Depth at Peak Storage= 0.04'
Bank-Full Depth= 0.50' Flow Area= 4.8 sf, Capacity= 89.99 cfs

8.00' x 0.50' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 3.0 '/' Top Width= 11.00'
Length= 179.0' Slope= 0.2458 '/'
Inlet Invert= 789.00', Outlet Invert= 745.00'

‡

Reach DC-E: East Downchute



Summary for Reach DC-W: West Downchute

Inflow Area = 2.25 ac, 0.00% Impervious, Inflow Depth = 5.74" for 25-Year, 24-Hour event
Inflow = 1.32 cfs @ 15.75 hrs, Volume= 1.075 af
Outflow = 1.32 cfs @ 15.77 hrs, Volume= 1.075 af, Atten= 0%, Lag= 1.3 min

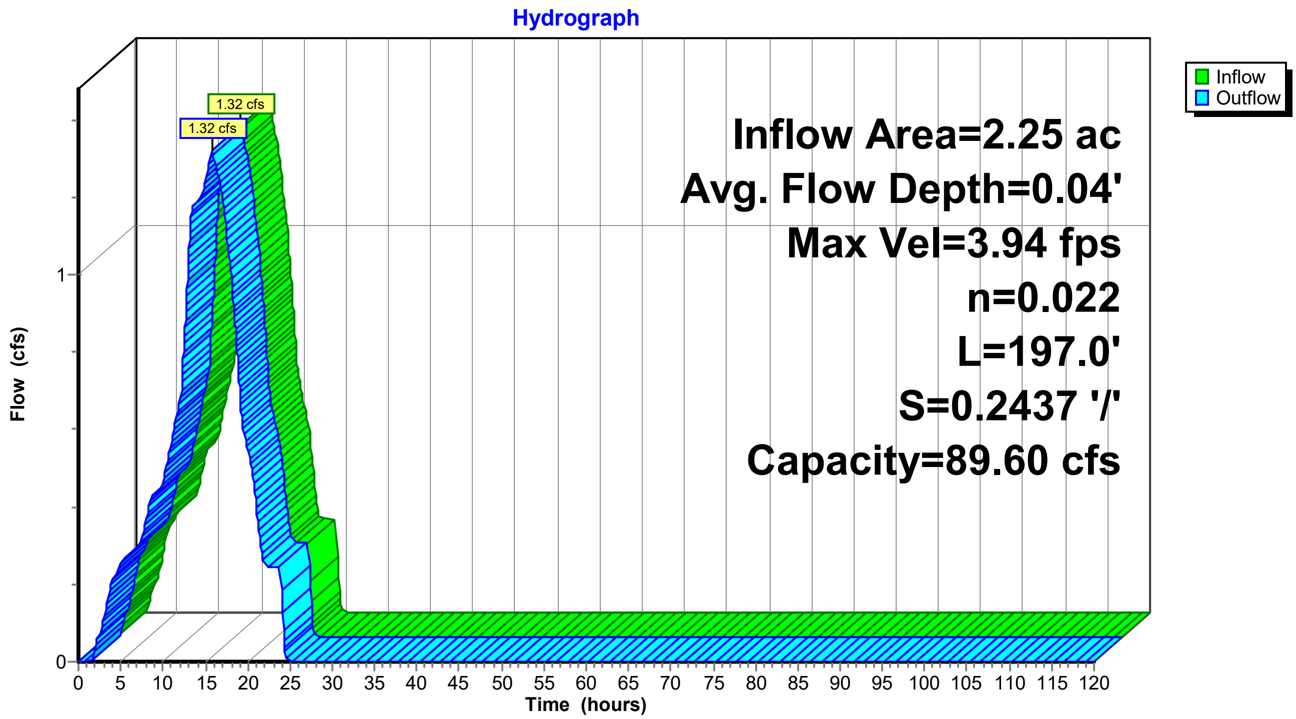
Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.94 fps, Min. Travel Time= 0.8 min
Avg. Velocity = 2.54 fps, Avg. Travel Time= 1.3 min

Peak Storage= 66 cf @ 15.76 hrs
Average Depth at Peak Storage= 0.04'
Bank-Full Depth= 0.50' Flow Area= 4.8 sf, Capacity= 89.60 cfs

8.00' x 0.50' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 3.0 '/' Top Width= 11.00'
Length= 197.0' Slope= 0.2437 '/'
Inlet Invert= 790.00', Outlet Invert= 742.00'

‡

Reach DC-W: West Downchute



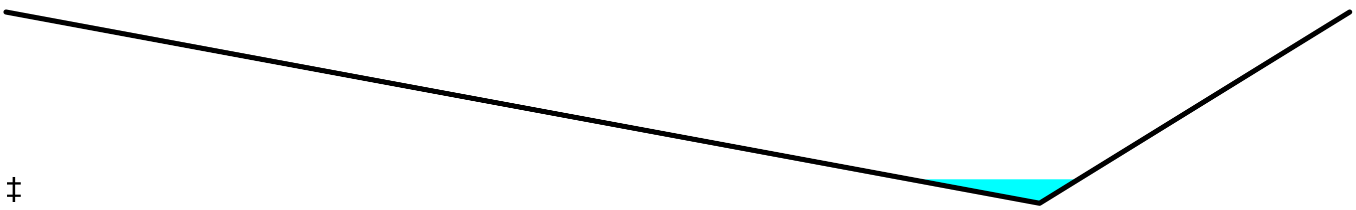
Summary for Reach TB-E: East Terrace Bench

Inflow Area = 2.18 ac, 0.00% Impervious, Inflow Depth = 5.74" for 25-Year, 24-Hour event
Inflow = 1.29 cfs @ 15.63 hrs, Volume= 1.045 af
Outflow = 1.28 cfs @ 15.75 hrs, Volume= 1.045 af, Atten= 0%, Lag= 6.8 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.99 fps, Min. Travel Time= 4.0 min
Avg. Velocity = 1.44 fps, Avg. Travel Time= 5.6 min

Peak Storage= 311 cf @ 15.68 hrs
Average Depth at Peak Storage= 0.32'
Bank-Full Depth= 2.50' Flow Area= 40.6 sf, Capacity= 320.83 cfs

0.00' x 2.50' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 10.0 3.0 '/' Top Width= 32.50'
Length= 482.0' Slope= 0.0104 '/'
Inlet Invert= 794.00', Outlet Invert= 789.00'



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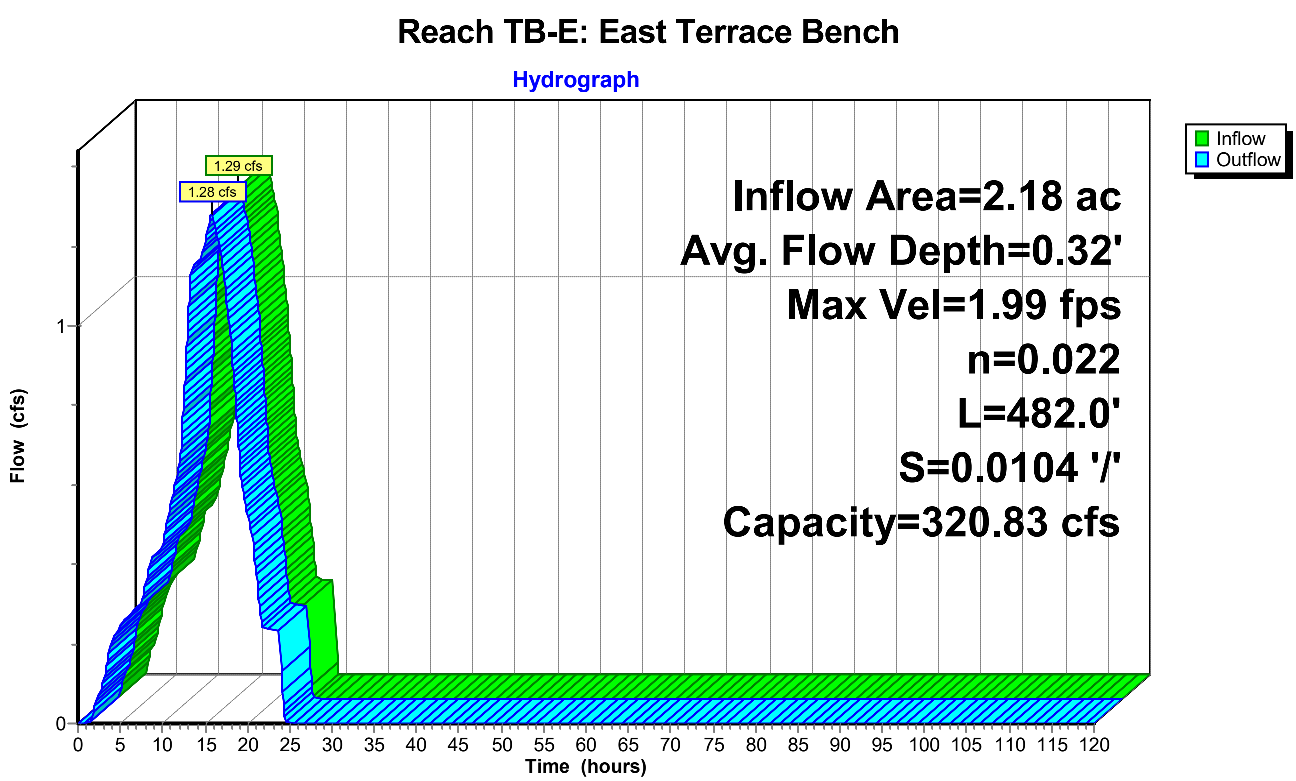


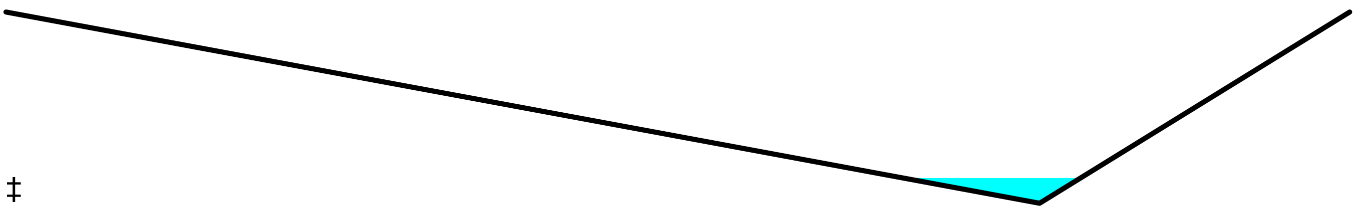
Summary for Reach TB-W: West Terrace Bench

Inflow Area = 2.20 ac, 0.00% Impervious, Inflow Depth = 5.74" for 25-Year, 24-Hour event
Inflow = 1.29 cfs @ 15.63 hrs, Volume= 1.051 af
Outflow = 1.29 cfs @ 15.75 hrs, Volume= 1.051 af, Atten= 0%, Lag= 7.2 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.84 fps, Min. Travel Time= 4.3 min
Avg. Velocity = 1.33 fps, Avg. Travel Time= 6.0 min

Peak Storage= 334 cf @ 15.68 hrs
Average Depth at Peak Storage= 0.33'
Bank-Full Depth= 2.50' Flow Area= 40.6 sf, Capacity= 288.76 cfs

0.00' x 2.50' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 10.0 3.0 '/' Top Width= 32.50'
Length= 476.0' Slope= 0.0084 '/'
Inlet Invert= 794.00', Outlet Invert= 790.00'



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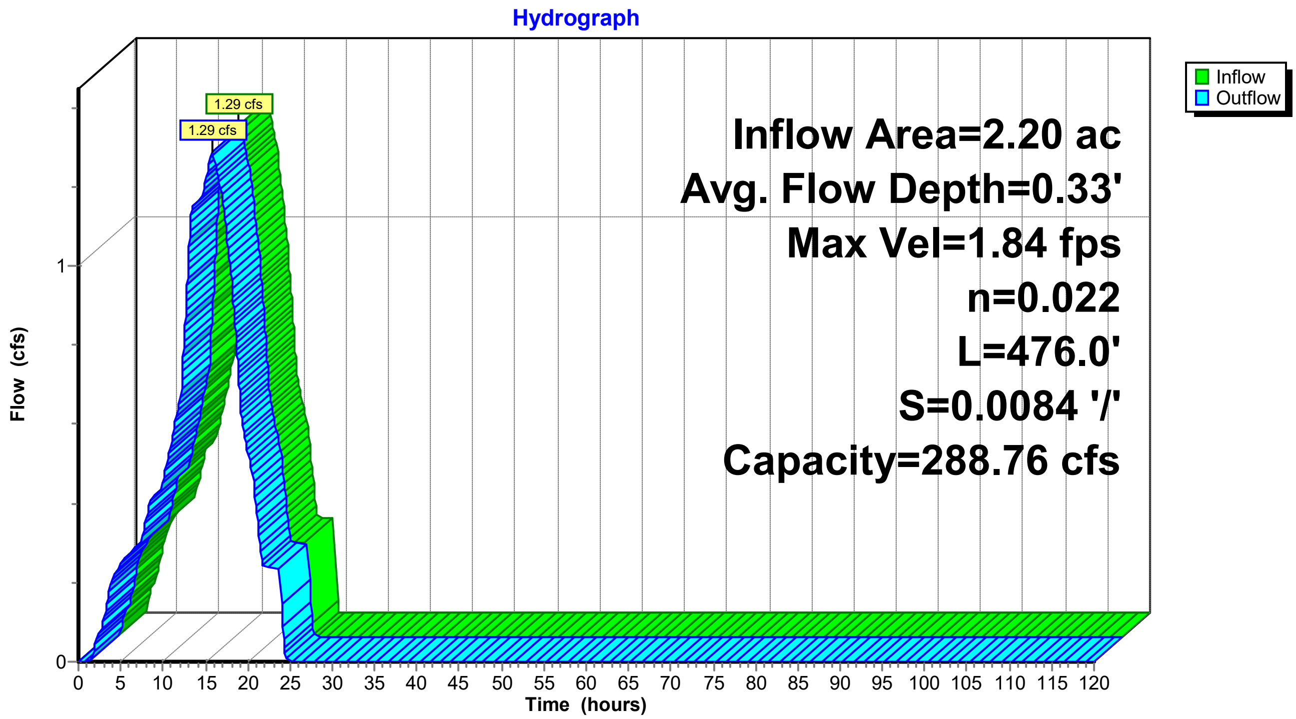
Reach TB-W: West Terrace Bench



ATTACHMENT 2
Revised Section 2.3
Design

2.3 DESIGN

Introduction

Zion Landfill, Inc. owns and operates the Zion Landfill (Facility) in the City of Zion, Illinois. Capacity of the existing Site 2 Landfill (Landfill) is projected to be depleted around the year 2028. To provide continued, uninterrupted operation of the Landfill, Zion Landfill, Inc. is proposing to expand the Landfill to the North (Site 2 North Expansion or Expansion).

This text provides an overview of key design features and evaluations of the proposed Site 2 North Expansion and is supplemented by the referenced design drawings, appendices, and associated text sections within this application to the IEPA.

Site 2 Landfill

The existing Facility consists of two older units that have ceased acceptance of waste and are closed (Site 1 Phase A and Site 1 Phase B), as well as the currently active unit referred to as the Site 2 Landfill (Landfill). The currently active Site 2 Landfill, which is proposed to be expanded as described in this application, includes an older, closed section (Old Site 2), as well as two prior expansion areas constituting the open, operating portion of the Facility. The proposed Site 2 North Expansion that is the subject of this application will be the third expansion of the Site 2 Landfill. The Landfill is permitted by the Illinois IEPA (Site No. 0978020002).

The original area of the Site 2 Landfill, referred to as Old Site 2, is a non-hazardous solid waste unit that was regulated under 35 IAC, Part 807. Old Site 2 commenced landfilling operations on December 23, 1981, pursuant to IEPA Permit No. 1980-24-DE. In 1993, a final cover system was constructed over the site. Siting approval for the first Site 2 Expansion (initially identified as Site 3 at that time) was granted by the Zion City Council on April 17, 1995 which approved a new landfill unit east of Old Site 2 including a “piggyback” onto the eastern portion of Old Site 2. The Site 2 Expansion was originally permitted under 35 IAC, Part 812, Subparts A and C, and is now regulated under 35 IAC, Part 811 regulations, which meet or exceed Subtitle D Federal landfill regulations.

A second expansion, referred to as the Site 2 East Expansion, included vertical and an approximate 26.5-acre horizontal expansion to the east of the previous Site 2 Expansion footprint. The initial phase of the Site 2 East vertical expansion was permitted on June 3, 2011, with the remainder of the expansion approved for development on June 13, 2014. The Site 2 East Expansion is regulated under 35 IAC, Part 811 regulations.

Site 2 North Expansion

The proposed Site 2 North Expansion includes a horizontal and vertical component. The proposed horizontal Expansion will advance the existing Landfill to the north, expanding the waste unit boundary of the existing Landfill by 65.6 acres and increasing the overall facility boundary 124 acres to the north. The proposed vertical Expansion will tie into the Site 2 East Expansion portion of the existing Landfill by vertically expanding over its north sideslopes. **Figure 2.3-1** provides a plan-view representation of the Expanded Landfill. **Figure 2.3-2** provides a cross-section representation of the Expanded Landfill.

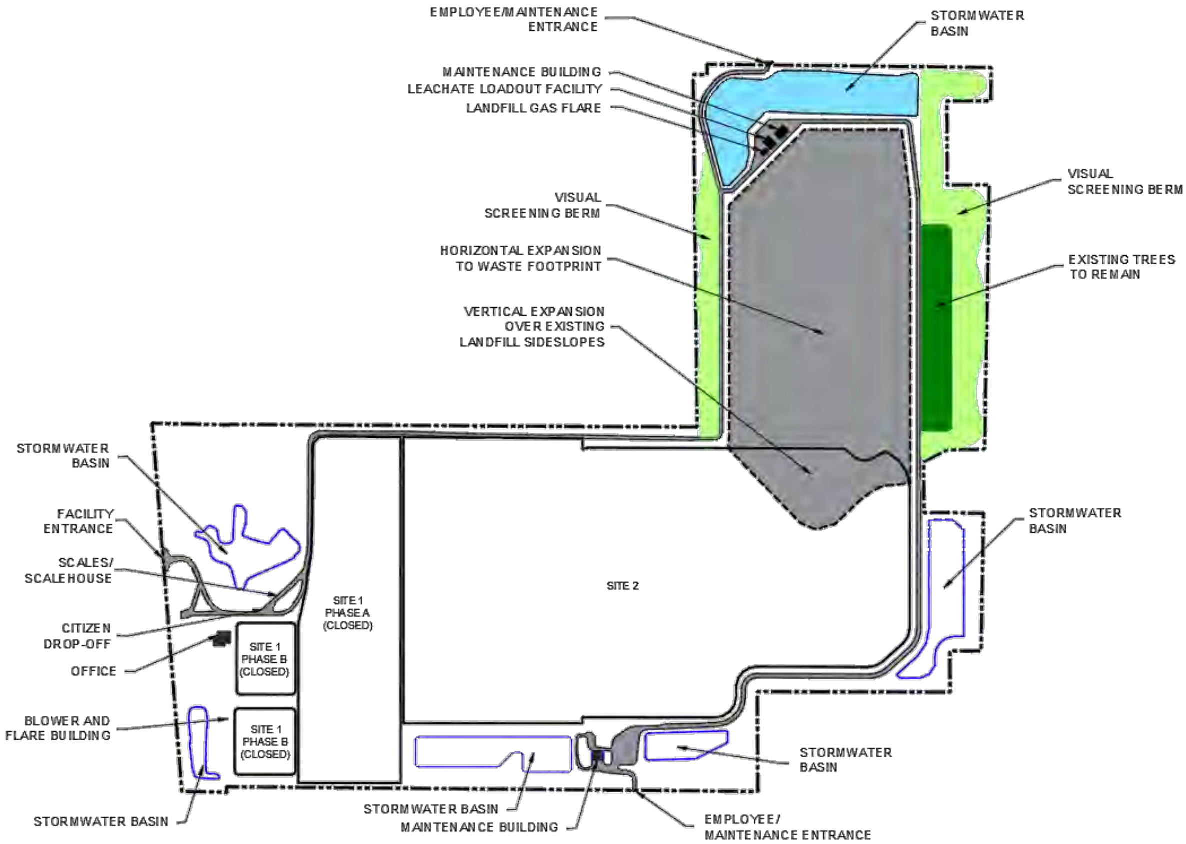


Figure 2.3-1
Proposed Expansion Facility Layout

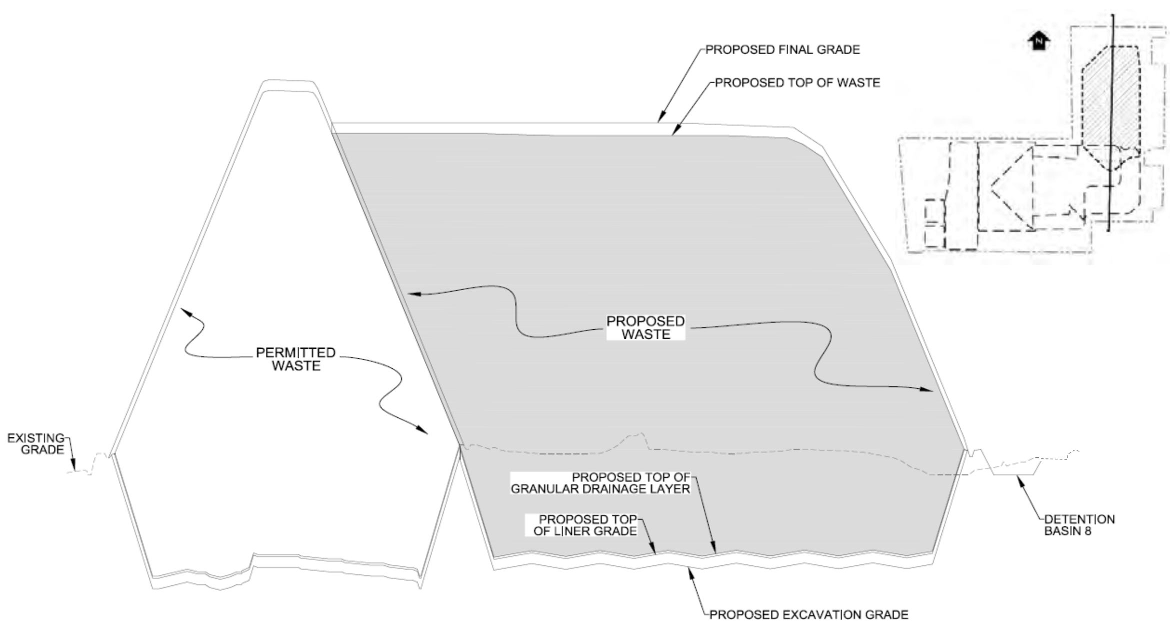


Figure 2.3-2
Cross Section of Expanded Landfill

APTIM

The Expansion will add approximately 12.7 million airspace cubic yards of waste disposal capacity (approximately 14 million tons) to the existing Landfill, which is anticipated to extend the life of the existing Landfill into 2044 assuming historical annual disposal volume and projected growth in annual disposal volumes is unchanged.

Most of the existing infrastructure supporting the landfill will remain in place as part of the expansion, including the landfill entrance, citizen drop-off area, administrative buildings, landfill gas processing area, maintenance shop, etc. A new leachate tank, landfill gas flare, and maintenance shop will be constructed to support the expansion. The leachate collection system, landfill gas collection and control system, and stormwater management system will be expanded to capture the footprint of the expanded landfill. Each of these features are further described in subsequent text.

Proposed Landfill Design Overview

The proposed Expansion design incorporates numerous extensive environmental safeguards. The design has been modeled based on site-specific conditions to ensure that it works in conjunction with its geologic and hydrogeologic conditions and facility location.

This proposed design includes modern landfill design features, including a composite liner system, a leachate collection and removal system, and a composite final cover. These design features have been successfully used at the existing Zion Landfill and many other modern landfills, have been well studied, and are known to be protective of the public health, safety, and welfare. A brief summary of each is described below:

1. *Composite Liner System*. The Expansion will utilize a composite liner system consisting of a minimum 5-foot-thick compacted cohesive soil liner with a maximum permeability 1 x 10^{-7} cm/sec and a 60-mil high density polyethylene (HDPE) geomembrane.

   This liner thickness significantly exceeds the regulatory standard of a 3-foot compacted clay liner system. In addition, though not required by regulations, the Landfill's composite liner will be further enhanced in the leachate collection sump areas. The composite liner system in these areas will include a geosynthetic clay liner (GCL) positioned between two (2) 60-mil HDPE geomembranes, all of which is underlain by a 5-foot-thick compacted clay liner, in addition to a double-sided geocomposite drainage layer below the compacted clay liner (see **Drawing D16**). This design significantly exceeds the federal and state regulations, which require only one 60-mil HDPE geomembrane.

   The composite liner system will effectively prevent the release of potential hazards from the Landfill. The liner system has been computer modeled, and the computer analysis demonstrates that the proposed Landfill will not impact existing or future groundwater quality (see **Section 2.7**).

2. *Leachate Collection System.* The Expansion design incorporates a leachate collection system consisting of a one-foot-thick permeable granular drainage layer placed above the composite liner on the Landfill floor and sideslopes. The leachate collection layer drains to collection points located along the perimeter of the waste boundary. Leachate will be removed from these collection points and properly managed.

3. *Final Cover System*. The final cover system of the Expansion consists of a low-permeability layer to inhibit precipitation from entering the Landfill and a protective soil layer used to maintain the long-term integrity of the cap. The low-permeability layer will include a 40-mil linear low-density polyethylene (LLDPE) geomembrane.

   The geomembrane will be underlain by a 2-foot-thick compacted cohesive soil layer with a maximum constructed permeability of 1 x 10^{-5} cm/sec. A double-sided geocomposite drainage net will overlay the geomembrane to drain infiltrated water away from the low-permeability layer. A protective soil cover layer will be placed over the geocomposite and will include a minimum of 2.5 feet of protective cover soil and six inches of vegetative cover soil. The Site 2 North Expansion will have a maximum slope of 4H:1V. In order to minimize the potential for erosion, the final slopes of the Landfill will be vegetated.

4. *Landfill Gas Collection System*. The Expansion will have an active landfill gas management system to collect and control gases generated through the natural decomposition of waste. The collected landfill gas will be flared or beneficially used once a sufficient amount of landfill gas is available.

Location of Landfill Design

Prior to developing the Expansion design, the property was reviewed with respect to location standards to determine whether the area was suitable for landfill development. As detailed in **Section 2.1** of this application, Illinois landfill regulations contain standards that restrict where landfills may be developed (35 IAC, Sections 811.102 and 811.302). Federal regulations and statutes also contain location requirements. The collective purpose of each of these location standards and requirements is to protect public health, safety, and welfare; the environment; and the structural integrity of the engineered landfill.

The selected location of the proposed Expansion will comply with all applicable federal, state, and local site location standards. **Section 2.1** provides a detailed description of each location standard and a demonstration that the standard is met. **Drawing D2** and **Drawing G2** shows the location of the proposed facility and demonstrates that the facility falls outside the applicable setback distances. **Appendix F** supplements these drawings when other maps, such as floodplain maps, are more appropriate to display setback compliance.

Designed Integration with Existing Facility

Existing Infrastructure

The existing scalehouse, haul roads, office, maintenance building, detention basins, leachate storage tanks, facility entrances, and other facilities will continue to be used as part of the facility Expansion. Additional infrastructure will be added as part of the proposed Expansion and will include:

- ❑ An additional maintenance building;
- ❑ An additional secondary entrance for employee and ancillary vehicles;
- ❑ Parking;
- ❑ Additional perimeter roads;
- ❑ Leachate storage and loadout facilities;
- ❑ Stormwater management basins;
- ❑ Landfill gas processing facilities; and

- ☐ Staging areas for equipment and supply storage.

See **Design Drawings** for the location of all structures associated with the Expansion.

Utilities

Utilities used to manage the facility will include, at a minimum:

- ☐ Electrical service to office/maintenance building, leachate/condensate pumps, landfill gas flare station, and scalehouse.
- ☐ Phone service to office/maintenance building and scalehouse.
- ☐ Two-way radio or cellular communication between supervising equipment operator(s), General Manager, and office.
- ☐ Water supply to the office and maintenance buildings.
- ☐ Sanitary service to the office and maintenance buildings.

Utilities will be provided and maintained at the site during the operating and post-closure care periods of the landfill for safety and compliance with the requirements of 35 IAC 811.

Physical Connection to Existing Landfill

The proposed Expansion will build vertically over a portion of the permitted Site 2 East Expansion and expand the waste footprint horizontally to the north of the Site 2 East Expansion.

A continuous composite liner and leachate collection system (both described in subsequent text) will be developed between the constructed Landfill and Expansion area, such that all areas of Landfill development have these underlying environmental controls and design features. Refer to **Drawing D17** for details depicting transitions between the existing Landfill and the Horizontal Expansion Area.

Hydrogeologic Considerations in Landfill Design

The design of the Expansion is supplemented by existing geologic and hydrogeologic features to provide a high level of environmental safety. An extensive site investigation was completed at the facility prior to developing the Landfill Expansion design in order to characterize both the geology and hydrology of the subsurface geologic units. This investigation included both an examination of regional geology and hydrogeology, as well as a site-specific exploration program. The exploration program included detailed logging of soil and rock samples, geotechnical laboratory testing, installation of monitoring wells, performance of field hydraulic conductivity tests, a coal mine reconnaissance, water level collection, and data evaluation.

The Wadsworth Formation, a low-permeability cohesive soil that has existed for over 10,000 years, is present across the proposed Site and will separate the footprint of the proposed Landfill Expansion from the uppermost aquifer. Field and laboratory test results and field observations indicate that this soil will effectively restrict vertical and horizontal movement of groundwater and will serve as an additional environmental safeguard at the proposed Expansion. The Wadsworth Formation contains a weathered portion directly below the Peoria Silt that has the potential to exhibit fractures within the upper 20 feet, although no fractures were identified at the site during the most recent investigation. The proposed excavation for the Expansion (approximately 60 feet) will remove this weathered zone. Additionally, loading stress caused by the Landfill will close any fractures within this zone. Thus, Wadsworth formation will provide a geologic barrier between the landfill and the uppermost aquifer that will provide very long-term protection of the environment.

Refer to **Section 2.2** for a complete description of geologic setting and to **Section 2.7** for the results of contaminant transport modeling for the Expanded Landfill. The Environmental Monitoring Program is described within **Section 2.8**.

Landfill Composite Liner System

An engineered composite liner system will be present in the proposed Expansion. The composite liner system will be constructed at the bottom and sides of the Expansion to contain the waste materials and prevent contaminants from leaving the Expansion and impacting groundwater. The composite liner will consist of a compacted cohesive soil liner overlain by a geomembrane (plastic) liner. The soil liner will consist of a minimum 5-foot-thick layer of recompacted cohesive soil with a maximum permeability of 1 x 10^{-7} cm/sec. The geomembrane will be a 60-mil HDPE liner. Additionally, a geocomposite clay liner will be installed in critical areas in the Expansion, namely the leachate collection sumps.

The liner system of both the Site 2 Landfill Expansion liner system and subsequent Site 2 East expansion have been permitted and constructed utilizing the same design. It is noted that the recompacted soil liner thickness exceeds the typical three-foot liner thickness used at other landfill facilities within Illinois.

The proposed liner system for the Expansion has been designed to function for the entire design period, pursuant to Section 811.306(c). The low-permeability component of the proposed liner system consists of low permeability till soils and are generally clayey soils that have survived for thousands of years. Long-term laboratory testing of HDPE geomembranes indicate that the service life of geomembranes is several hundred years (see **Appendix K**). In addition, **Appendices J** and **K** provide a demonstration that the proposed liner system will be stable (i.e. will function) under both short-term and long-term conditions. **Appendix K** includes a demonstration that the composite liner system will perform better than a five-foot clay liner system.

Low-Permeability Earth Liner

The low-permeability earth liner for the Expansion will meet regulatory requirements by providing a minimum 5-foot layer of compacted cohesive soil with a maximum hydraulic conductivity of 1 x 10^{-7} cm/sec. The earth liner thickness exceeds typical three-foot liners as an additional environmental safeguard.

It is anticipated that the low-permeability earth liner will be constructed of Wadsworth formation soils due to the favorable physical properties for construction and low hydraulic conductivity. As discussed in **Section 2.2** of this Application, the native soils have permeabilities that are less than the 1 x 10^{-7} cm/sec requirement.

Roots, boulders, debris, and other deleterious material will be removed from the soil prior to compaction. Frozen soil will not be used for construction and liner material will not be placed on frozen ground. Each soil layer will be worked sufficiently to break down oversized clods, and obtain acceptable moisture and density requirements, as defined by the CQA Plan. Earth Liner material, placement, and compaction standards are provided in the CQA Plan located in **Appendix O**.

Geomembrane

The geomembrane will be installed above the Earth Liner by personnel experienced in liner installation. The geomembrane liner will consist of panels of 60-mil textured HDPE. Geomembrane materials, installation, seaming, and testing will be performed in accordance with the CQA Plan located in **Appendix O**.

The geomembrane panels will be arranged to minimize the number of field seams. It is assumed that the geomembrane panels will be 22.5 feet wide by 400 feet long (panel lengths and widths may vary by manufacturer's specifications at the time of construction). **Drawing D9** provides a conceptual geomembrane panel layout for the Landfill. The actual constructed layout of the geomembrane panels will be provided with each cell construction certification report. Penetrations through the geomembrane liner system are not proposed or anticipated.

The geomembrane liner subgrade will be prepared to be smooth and free of rocks, stones, roots, sharp objects or other undesirable debris. In order to maintain stable side slopes, the geomembrane liners will be anchored beyond the limits of the waste into the anchor trenches as shown on **Drawing D15**.

The geomembrane liner will also be protected from sharp items in the waste by the granular drainage blanket which will serve as part of the leachate collection system on the Landfill floor and sideslopes.

Based on current technology, a dual fusion wedge weld is generally the preferred seaming method to join panels and will generally be used for areas except at sumps, corners, or other irregular areas where an extrusion weld is necessary. Extrusion welds are also highly effective welds and are anticipated to be used to repair destructive sample locations, and any repair areas.

The geomembrane will have sufficient strength and durability to function for the design period under the maximum expected loading imposed by the waste and equipment and stresses imposed by settlement, temperature, construction, and operation, pursuant to Section 811.306(e). Calculations demonstrating the strength and durability of the HDPE liner are provided in **Appendix J**. Demonstration that HDPE is compatible with the Landfill environment is provided in **Appendix K**.

Geosynthetic Clay Liners (GCLs)

Within each leachate collection sump, a GCL will be beneath the 60-mil HDPE geocmembrane and placed on top of the 5-foot thick recompacted cohesive soil liner as shown on **Drawing D18**. GCL materials and installation will comply with the CQA Plan in **Appendix O**.

CQA Documentation

Liner construction, documentation, and certification will be performed in accordance with the CQA Plan contained in **Appendix O** of this Application. A CQA Officer will supervise and be responsible for all inspections and testing. The CQA Officer will be an independent licensed Professional Engineer. A construction acceptance report will be prepared under the direct supervision of the CQA Officer and submitted to the IEPA after completion of each major phase of construction.

Leachate Management

Origin of Leachate

Leachate is any liquid that has contacted waste. Leachate can come from several sources, including the biological breakdown of waste or the movement of infiltrated moisture, such as rainwater, through the waste. Leachate generation will vary depending on the composition and moisture content of the incoming waste (i.e., dry waste will absorb more water than wet waste). Most of the leachate in a conventional landfill stems from precipitation that falls on the active area of the landfill, or from precipitation that percolates through daily/intermediate cover. The low permeability final cover employed at the Expansion will essentially eliminate long-term leachate generation on sections of the landfill that have been capped.

The rate of leachate generation and the composition of the leachate are influenced principally by the following factors:

1. The availability and potential for infiltration or seepage of water into the landfill.

2. The physical and chemical characteristics of the waste (i.e. the moisture content, absorptive capacity, and solubility of the waste).

3. The environment in which the biological decomposition process takes place (i.e. pH, availability of oxygen and temperature).

Municipal solid waste landfill leachate typically contains the following chemicals in order of decreasing concentrations: 1) dissolved and suspended solids including salts (i.e. sodium chloride), sulfates, and sodium bicarbonate; 2) metals (principally iron and zinc); and, 3) organic compounds. The waste decomposition process will also yield methane, carbon dioxide, and traces of other gases. Some heat will be generated as the waste decomposes.

The rate of decomposition in a landfill depends on the type of waste and the landfill environment in which the waste is present, with moisture content being one of the primary factors. Food wastes typically decompose first, followed by paper, wood, textiles, and discarded un-stabilized plastics. Microbes that are initially present in the waste or introduced with the materials used as daily cover will initiate the aerobic portion of the decomposition process. Inert materials (soils, coal combustion byproducts, grit, some plastics, and some construction/demolition debris) which do not readily degrade will essentially remain unchanged by the decomposition process.

Overview of Leachate System

The Expansion will include a leachate collection system to collect and remove leachate for treatment and disposal. The vertical expansion area will be underlain by the currently permitted leachate collection system at the facility. The existing leachate collection system has been evaluated for adequacy for the vertical expansion (see **Appendix K**). This system will be expanded to incorporate the horizontal expansion Area as cell development progresses within the Expansion. Though the Facility has historically been permitted for leachate recirculation, leachate will not be recirculated within the expanded landfill and is therefore not included in the Expansion design.

Throughout the Landfill, the leachate collection system will consist of a highly permeable leachate drainage layer overlaying the entire base of the Landfill and a system of leachate collection pipes, collection sumps, collection risers and cleanout risers. The drainage layer material will have a minimum hydraulic conductivity of 1.0 x 10^{-1} cm/sec, which will facilitate the flow of leachate across the base of the Landfill.

A nonwoven geotextile will be installed above the entire drainage layer. The purpose of this geotextile is to serve as a filter to the leachate as it enters the drainage layer. This geotextile minimizes the potential for clogging within the drainage layer. The geotextile seams will be overlapped, heat bonded, and/or field sewn as required by the CQA Plan (see **Appendix O**).

Once leachate passes through the geotextile filter, it will flow by gravity through the granular drainage material, which is anticipated to be coarse sand or pea gravel. Leachate collection lines consist of perforated HDPE pipe situated in a gravel or stone envelope. The base composite liner for each cell in the expansion is designed to slope at a minimum of 2.0 percent toward the leachate collection pipe. The maximum horizontal distance from the leachate drainage divide to the collection point is approximately 192 feet.

Once leachate reaches the collection pipe, the collection pipe is designed to flow by gravity to sumps (collection points) located at the base of the landfill sidewalls. The leachate collection pipes will be sloped at a minimum of 1.0 percent to promote drainage within the pipes to the leachate header pipes and leachate collection sumps.

Access to the sumps will be provided by dual risers which will be placed on the landfill sidewalls and will extend beyond the waste boundary. The riser pipes will extend from the collection sumps to the edge of the waste footprint, where the point of extraction is accessible. Pumps will be placed within the risers to remove leachate from the landfill and will be equipped with a leachate level detection system for monitoring leachate levels. A force main will be used to convey leachate from the sumps to the leachate storage tank. All leachate piping outside of the waste limits will be dual-contained.

The location and details of the components of the leachate collection system are shown on **Drawings D10**, **D15**, **D16**, **D17**, **D18**, and **D19**. Material and installation specifications for the various components are provided in the CQA Plan in **Appendix O**.

Safeguards of the Leachate Collection System

The leachate collection system for the proposed Expansion is appropriately designed and provides the following design safeguards:

1. The highly permeable granular drainage layer will have a minimum hydraulic conductivity of 1.0 x 10^{-1} cm/sec and be a minimum of 12-inches thick across the floor of the Landfill. This drainage layer will promote flow to the collection pipes, minimizing the leachate head above the HDPE composite liner system.

2. The collection pipes are capable of handling volumes far exceeding the maximum estimated leachate flow volumes for the Expansion.

3. The leachate collection cleanout risers will allow access to all points along the collection lines for cleaning out the pipes and back-flushing, if necessary.

4. The granular pipe envelope will serve as a conduit to other collection points in the unlikely event that a temporary clog or localized pipe failure occurs.

5. All of the components of the leachate collection system will be constructed of materials that are chemically resistant to the anticipated composition of leachate.

Maintaining the Leachate Collection System

The leachate collection system of the Expansion has been designed to efficiently collect leachate throughout the operating life, post-closure care period, and beyond. The system is designed to handle leachate quantities determined by computer modeling and consistent with rates at similar facilities. The drainage layer has been designed to maintain laminar flow and will be constructed of materials that are chemically resistant to leachate. The CQA Plan in **Appendix O** requires testing (ASTM D2488 and ASTM D3042) to verify that the granular materials will be compatible with the expected leachate at the landfill.

The leachate management system has been designed to safely handle leachate during routine maintenance and repair activities. To facilitate cleanout, each collection pipe will be connected to a cleanout riser. The proposed cleanout riser locations are shown on **Drawing D10**. The leachate collection pipes will typically be cleaned by hydraulic jetting or flushing, which requires access from only one end of the pipe. The leachate forcemain will also be cleaned by jetting. Hydraulic flushing or jetting typically uses a 1-inch hose connected to a 3-inch diameter nozzle assembly to deliver high-pressure water to remove obstructions. The hose and nozzle will fit through the 6-inch diameter leachate collection pipe. The 3-inch diameter nozzle can produce approximately 3,000 psi of hydraulic pressure, allowing it to easily breakup any obstructions.

Any liquid or debris resulting from the cleaning of the leachate collection line will be properly handled and disposed. All liquid will be treated as leachate, and any solid debris will be returned to the active face of the Landfill or hauled by a properly licensed truck to another permitted disposal facility.

The leachate collection pipes will be cleaned and maintained as necessary. The cleanout system has been designed so that all work can be performed at the ground surface. The leachate collection and management system will be routinely inspected for evidence of clogging or general system repair. Areas specifically targeted for maintenance inspections and monitoring include collection pipes (leachate levels), extraction points, leachate forcemains, leachate storage tanks, and leachate containment structures. Any observed damage or deficiencies will be quickly repaired following detection.

Leachate Collection and Disposal

As leachate collects in the sumps of the Expansion, it will be extracted using submersible pumps. The type of pumps used in the sumps will depend on the actual quantity and quality of leachate generated for each cell and is anticipated to vary over the life of the Landfill. Pumps will be installed with an automated leachate-level activated switch to pump leachate from the collection system when the leachate level within each sump rises to the level of the lowest leachate collection pipe entering the sump. The leachate drainage and collection system will not be used for the purpose of storing leachate. Any leachate system piping outside the waste boundary will be dual-contained. Once collected and removed, the leachate will be conveyed to either a publicly owned treatment works (POTW) facility or a privately owned treatment works facility for treatment and disposal or temporarily stored in a leachate tank.

Leachate Storage Tank and Secondary Containment System

35 IAC Section 811.309(d) requires that sufficient storage capacity is provided to contain the volume of leachate that is generated assuming the maximum daily leachate generation rate calculated in accordance with 35 IAC Section 811.307. In accordance with regulatory requirements, it is assumed that five days of storage capacity will be required, given that containment of leachate within onsite storage tanks are the only approved storage option. Calculation of the maximum daily leachate generation rate and required 5-day storage capacity is provided in **Appendix K.9**, resulting in a calculated storage requirement of 3,881 gallons under closed conditions.

The Facility currently operates two 32,000-gallon leachate storage tanks on the south side of the Facility and a 165,000-gallon leachate storage tank on the north side of the Facility which are permitted by IEPA to provide needed storage capacity for the existing Landfill. The 165,000-gallon tank is located within the proposed Expansion footprint, and therefore will be removed prior to construction of the first cell of the Expansion and relocated to the northwest corner of the proposed Expansion footprint. These tanks will continue to be used to serve the Expansion.

All on-site storage structures and secondary containment facilities comply with the conditions and specifications required by 35 IAC Section 811.309. The storage tanks will incorporate secondary containment equivalent to the protection provided by a 2-foot-thick clay liner having a permeability no greater than 1×10^{-7} cm/s. The primary tank shells will be coated steel or other material that is compatible with leachate.

Leachate Monitoring

Leachate will be sampled in accordance with 35 IAC Section 811.309(g). Sampling will be conducted as long as the leachate collection system is in operation. Test results will be submitted to the IEPA. The schedule for the leachate monitoring program is discussed in further detail in **Section 2.8** of this Application.

Evaluations of the Leachate Collection System

The leachate collection system has been evaluated to ensure that its design is appropriate for use at the Expanded Landfill. Calculations provided in **Appendix K.8** demonstrate that the leachate collection system is appropriately sized to convey the maximum estimated leachate flow volumes expected for the Landfill. The proposed design also exceeds the IEPA performance requirements by maintaining less than the maximum allowable one foot of leachate head across the liner floor during steady-state conditions.

In addition, the following key findings are summarized, as further presented in **Appendices J and K:**

1. The leachate collection system is capable of supporting the weight of the overlying landfill, including operating equipment (see **Appendices K.3 and K.4**).

2. The potential for differential settlement of the underlying compressible Wadsworth Till soils due to the weight of the landfill has been evaluated to ensure that the leachate collection pipes will continue to function as intended after settlement. The differential settlement was found to be nominal; the leachate collection pipe slope is appropriate for development (see **Appendix J.3-B**).

3. The maximum leachate head in the granular drainage blanket was calculated based on the estimated leachate generation rates, the hydraulic conductivity of the drainage layer and the leachate collection system design. The analysis indicates that the maximum leachate head in the granular drainage blanket will not exceed 12 inches, as required by regulations (see **Appendix K.6**).

4. The efficiency of the leachate collection pipes to collect and transport the maximum estimated leachate volume was assessed. The analysis indicates that the existing 6-inch diameter pipes beneath the vertical expansion area and the proposed 6-inch diameter pipes beneath the horizontal expansion area are appropriately sized to transport the peak percolation rate (see **Appendix K.8**).

Final Cover System

The Landfill will be covered with an engineered final cover system which will meet or exceed all federal, state, and local requirements. The final cover will be used to: 1) minimize the infiltration of precipitation, 2) prevent the release of landfill gas to the atmosphere, 3) support vegetation, and, 4) eliminate accessibility to the waste by vectors. The proposed final cover system is a multi-layer system consisting of:

1. A 12-inch-thick intermediate cover layer (foundation soils)

2. A 24-inch-thick low permeability compacted cohesive soil liner (maximum constructed hydraulic conductivity of 1 x 10^{-5} cm/sec)

3. A 40-mil double-sided textured LLDPE geomembrane liner

4. A geocomposite drainage layer

5. A minimum three-foot-thick protective layer overlaying the low permeability layer, with the uppermost six inches consisting of soil suitable for vegetation.

6. Vegetation consisting of grass or similar shallow-rooting vegetation

The final cover system will cover the entire Landfill and connect with the bottom liner system. A typical cross section of the proposed final cover is shown in **Drawing D15**, and the contours of the final landform are shown on **Drawing D11**. As shown on **Drawing D15**, the low permeability layer of the final cover will connect with the bottom liner system. The constructed slope of the final cover will be a minimum of 10 percent, with typical sideslopes of 4H:1V. The following text provides a more detailed description of each layer within the Landfill final cover system.

Low Permeability Layer

The 24-inch low permeability soil layer will have a constructed hydraulic conductivity of 1 x 10^{-5} cm/sec or less. The low permeability soil layer will be placed and compacted in lifts. Each soil layer will be uniformly placed with roots, cobbles, debris, organic, and other deleterious material removed prior to compaction. Additionally, the final surface will be inspected prior to geomembrane installation to ensure that no rocks, roots, or other objectionable items are exposed on the cover surface. All construction will be conducted and documented in accordance with the procedures outlined in the CQA Plan located in **Appendix O** of this application.

Geomembrane Layer

A 40-mil linear low-density polyethylene (LLDPE) geomembrane will be included in the composite final cover system for the facility. The material specifications for the 40-mil geomembrane liner material are included in **Appendix O** of this application. The geomembrane layer will serve as an impermeable barrier against infiltration of moisture through the final cover into the Landfill as well as a barrier preventing landfill gas from migrating out of the Landfill.

Geocomposite Drainage Layer

Overlaying the geomembrane layer is a geocomposite drainage layer. The geocomposite drainage layer consists of a geonet (drainage net) sandwiched by two non-woven needle-punched geotextiles. The geocomposite drainage layer will discharge at the toe of the Landfill final cover. The end of the geocomposite drainage layer will be protected, as shown on **Drawing D15**, and will discharge into a gravel envelope with drainage pipes installed with a nominal separation of 200 feet. The purpose of these outlets is to release hydraulic pressure and provide a discharge path into the perimeter stormwater channels. The material specifications for the geocomposite material are included in **Appendix O** of this Application.

The geocomposite drainage layer will serve three purposes:

1. Lowers the hydraulic head acting on the final cover, which improves the slope stability of the final cover;

2. Removes water from the final cover, reducing the potential for it to infiltrate into the waste mass; and

3. Provides a cushion layer between the geomembrane and the protective layer, reducing the potential for puncture of the geomembrane.

The geocomposite will be installed and tested in accordance with the requirements of the CQA Plan detailed in **Appendix O** of this Application.

Protective Layer

A protective layer consisting of a minimum of 36 inches of soil will be placed over the geocomposite drainage layer to protect the underlying layers from frost, desiccation, erosion, and penetration by roots or vectors. On-site material will be supplied for use in constructing the protective layer. The uppermost six inches of the material will consist of soil capable of supporting vegetation. The protective layer will be tested and placed in accordance with the requirements detailed in the CQA Plan, **Appendix O** of this Application.

Vegetative Cover

The vegetative cover planned for the Landfill is intended to protect the final cover from wind and water erosion, as well as to minimize run-off and maximize evapotranspiration. The vegetative cover will be placed after completion of the protective layer at the appropriate time for successful germination and growth.

The vegetative cover will consist of a variety of grasses that will: 1) protect the soil surface against erosion; 2) not interfere with the integrity of the geocomposite drainage layer or low permeable layer; 3) increase evapotranspiration thereby minimizing infiltration into the Landfill; 4) provide for sufficient stormwater management; and 5) improve the appearance of the final land surface. The vegetative cover will be established in accordance with the CQA Plan provided in **Appendix O**.

Time of planting is a critical factor in successful establishment of plants from seeds. Seed will be planted at the appropriate time for successful germination and growth based on soil temperature and precipitation, to be determined each year at the time of planting. Generally, seed will be planted in the spring or late summer/early autumn. Mulch and/or erosion control blankets will be applied as needed to control erosion and enhance vegetation establishment.

Final Cover Construction and Maintenance

The final cover will be constructed in accordance with the Specifications and Construction Quality Assurance guidelines outlined in the comprehensive CQA Plan (**Appendix O** of this Application). The low permeability layer of the final cover system will be constructed no later than 60 days after placement of the final lift of solid waste. The final protective layer will be placed as soon as possible after placement of the low permeability layer to prevent desiccation, cracking, freezing or other damage to the low permeability layer. The final protective layer will be 36-inches thick, which exceeds to frost penetration anticipated at the facility (approximately 20-24 inches). Thus, the final protective layer is sufficiently thick to prevent frost penetration into the underlying low permeability layer. Cover maintenance will be performed as necessary to maintain the final cover to meet the design objectives.

Cover Percolation

After placement of final cover, virtually all of the precipitation which falls on the Landfill will be diverted into the stormwater management system. Controlled runoff, evaporation, evapotranspiration, and barrier layers will minimize percolation through the final cover system.

Final Landform

Suitable grasses will be used for the vegetative cover, which will provide erosion protection. The grass seed mixture that is selected will be amenable to the soil quality/thickness, slopes and moisture/climatological conditions that exist and will not require significant maintenance. The seed mixture will be selected to protect the low permeability liner system from root penetration. Generally, a protective layer that is 450 mm (17.7 in.) to 600 mm (23.6 in.) is adequate to protect against root penetration. Since the protective layer will be 36-inches thick and the grass seed mixture will be carefully selected, the protective layer is deemed more than adequate to prevent root penetration from occurring in the geocomposite drainage layer or low permeability layer. Long-term management of grassed areas will require regular mowing. Fertilizer, lime, and mulch will be used at rates necessary to establish proper growth of the seed.

The maximum elevation of the Landfill in the horizontal expansion will be approximately 896 feet above MSL and in the vertical expansion it will be approximately 898 ft MSL. The gentle slopes of the Landfill top are proposed to be constructed no flatter than 10 percent to promote drainage from the top of the landform, allowing for differential settlement. The Landfill will have maximum slopes of 4H:1V on the sideslopes.

Terrace ditches and lined terrace downslope ditches and/or letdown culverts will be incorporated into the final slopes to further minimize erosion, as described in the Stormwater Management Plan in **Section 2.4** of this application.

Stormwater Management

The existing Landfill has a detailed stormwater management system that has been reviewed and permitted by the IEPA. Stormwater that falls on the Landfill is intercepted by the terrace benches and is directed to downslope ditches (also referred to as downchutes) or letdown pipes. The downslope ditches and letdown pipes convey water into ditches that follow the perimeter of the Landfill.

All existing stormwater controls that are not in the footprint of the proposed Expansion will continue to be utilized based on their proven performance. The Vertical Expansion Area will build upon a portion of the existing Landfill. As such, a portion of the stormwater that falls on the Vertical Expansion will utilize stormwater controls of the existing Landfill.

The Horizontal Expansion Area will be developed to the north of the existing Site 2 East Expansion area. The western and northern ditches around the horizontal expansion drain to the Detention Basin 8 system. The eastern ditches of the horizontal expansion drain to Detention Basin 5R.

The proposed Landfill will largely be developed with similar controls as the existing Landfill based on their proven performance, although it is noted that some of these features' dimensions have been modified as appropriate for the new development. However, the overall conveyance strategy remains similar.

All stormwater modeling has been completed that exceeds state, federal, and local requirements. Analyses indicate that stormwater will be discharged at a controlled rate for all modeled storm events, including the 100-year storm. Please refer to **Section 2.4** of this application for a description off the stormwater management plan and **Appendix M** for a demonstration that all controls are appropriate for this Landfill.

Landfill Gas Management

Landfill gas is a natural byproduct of the decomposition of waste in a landfill. Landfill gas contains methane, carbon dioxide, nitrogen, and other trace constituents. When captured for reuse, landfill gas is an important source of renewable energy. The Landfill includes systems to monitor and manage landfill gas.

Both below grade and above grade air monitoring will be provided at the facility. The Landfill gas monitoring probes and detection devices will be constructed/installed in accordance with all applicable federal and state requirements. A detail of a typical monitoring probe is included on **Drawing D20** and the proposed conceptual landfill gas management system is shown on **Drawing D14**.

The low permeability composite bottom liner and final cover systems minimize the potential for landfill gas to migrate from the waste boundary. Landfill gas will typically migrate through the most permeable zones within the landfill waste and will be less likely to migrate through the low permeable liner and cover systems. The landfill gas will typically migrate through pathways in the waste, flowing toward a landfill gas extraction well.

An active gas collection system already exists at the permitted Landfill and will be expanded to withdraw landfill gas from the Expansion area. The proposed gas system will collect gas and destroy methane and other constituents, reducing the potential for odors and greenhouse gas emissions. The existing perimeter odor misting system will also be expanded as the Expansion develops to neutralize odors, should they occur. The landfill gas is planned to be flared or may be recovered for reuse as energy at an onsite gas-to-energy facility or for other beneficial use. A detail of a typical vertical landfill gas extraction well and typical caisson landfill gas extraction well is shown on **Drawing D26**. Landfill gas extraction wells will be fitted with a pump to remove leachate as necessary to ensure adequate landfill gas extraction.

Landfill Gas Composition

Landfill gas quality is an important determinant of the end use for collected landfill gas. Landfill gas results from the decomposition of the waste, and therefore the quality of the landfill gas produced depends almost exclusively on the decomposition process. Landfill gas quality is different at each landfill and will also vary at different stages during the design life of a given landfill. In order to more fully appreciate how landfill gas quality will vary, it is important to understand the waste decomposition process.

The biological and chemical decomposition of solid waste results generally in the formation of heat, leachate, and landfill gas. Decomposition will begin soon after the waste material is placed in the landfill. The rate of decomposition will be affected by the availability of moisture, the physical and chemical characteristics of the waste, and the availability of oxygen. Waste decomposition passes through three phases, beginning with aerobic decomposition and proceeding to a two-phase anaerobic decomposition.

Food wastes typically decompose first, followed by paper, wood, textiles, and discarded un-stabilized plastics. Microbes that are initially present in the waste or introduced with the materials used as daily cover will initiate the aerobic portion of the decomposition process. Inert materials (soils, coal combustion byproducts, grit, some plastics, and some construction/demolition debris) which do not readily degrade will essentially remain unchanged by the decomposition process. The waste decomposition process will also yield methane, carbon dioxide, and traces of other gases. Some heat will be generated as the waste decomposes.

Initially, aerobic decomposition will take place with the principal by-products being carbon dioxide, leachate, and heat. Aerobic decomposition requires oxygen to continue. Modern landfills are designed to keep oxygen out as a method of fire control. Therefore, as the finite amount of oxygen within the waste is depleted, anaerobic decomposition will begin to take place. During the first phase of anaerobic decomposition, carbon dioxide and hydrogen are the principal by-products. Once the first phase of anaerobic decomposition is completed, the second phase of anaerobic decomposition begins. This decomposition results in the generation of methane (CH_4) and carbon dioxide (CO_2). Trace amounts of nitrogen, hydrogen sulfide, and other non-methanogenic organic compounds (NMOCs) are also present in the second phase of anaerobic decomposition. The typical composition of landfill gas generated at a conventional sanitary landfill during this second phase is summarized in **Table 2.3-1**.

Table 2.3-1 Typical Composition of Landfill Gas	
Landfill Gas	**Component Percentage* (Dry Volume Basis)**
Methane (CH_4)	50% to 55%
Carbon Dioxide (CO_2)	45% to 50%
Other gases (oxygen (O_2), nitrogen (N_2), sulfides, etc.)	2% to 5%
Source: U.S. EPA, *Landfill Gas Energy Basics*, LFG Energy Project Development Handbook, June 2017.	

Quantity of Landfill Gas

The rate of landfill gas generation is dependent upon the waste decomposition process, which is controlled by many factors including moisture availability, waste composition and availability of oxygen. Diversion of paper, aluminum, plastics, and landscape waste may also have an effect on the generation of methane. The total quantity of landfill gas that will be generated can be estimated based on measurements of gas quantities at existing conventional landfills. Actual monitoring of the landfill gas at the Landfill will verify the quantity and quality of the landfill gas.

The quantity of landfill gas that is generated also depends on the quantity of waste being decomposed. The rate of waste decomposition and landfill gas production is primarily controlled by the moisture content of the waste. The most significant landfill gas generation rates occur when moisture in the form of leachate flows through the waste, transporting the bacteria and nutrients necessary for decomposition. This movement of leachate through the waste occurs only when the moisture content of the waste is above field capacity or when infiltrated moisture passes through preferential pathways that may exist in the waste. The final cover of the Landfill has been designed to minimize the infiltration of moisture into the waste after closure.

Typically, generation of significant quantities of landfill gas occurs for a period of thirty to forty years after placement. Gas generation rates are calculated in **Appendix L** for the existing Landfill; these calculations will be updated as Landfill development (including development in the Expansion area) proceeds.

Landfill Gas Collection

Landfill gas generated will be controlled in accordance with all applicable current and future regulations, including applicable Clean Air Act New Source Performance Standards (NSPS) and 35 Ill. Admin. Code requirements. The current *NSPS Landfill Gas Collection and Control System Design Plan* for the Landfill is contained in **Appendix L** and will be periodically updated as Landfill development proceeds. The gas collection system and all associated equipment will be part of the facility. Under no circumstance shall the gas collection system compromise the integrity of the liner, leachate collection system, or final cover system.

The gas collection system will be designed and constructed to function for the entire design period and be able to accommodate changing gas flow rates or compositions. **Drawing D14** illustrates conceptual extraction well locations for the Expansion and **Drawing D26** shows a typical extraction well from such a system. The gas collection system shall be operated until the waste has stabilized enough to no longer produce methane quantities that exceed allowable concentrations in 35 IAC Section 811.311(a)(1-3).

Multiple gas extraction devices will allow gas to be efficiently extracted from the Landfill during all stages of development. During cell construction, caisson vertical extraction wells will be constructed overlying the leachate collection layer. The caisson wells will consist of perforated piping surrounded by coarse aggregate within the caisson. The landfill gas collection piping will be vertically extended as cell filling progresses, and the caisson will be raised during each extension until final grades are achieved. This will enable collection of landfill gas soon after waste placement and provide direct drainage of leachate and gas condensate to the leachate collection system. Horizontal gas collection piping will supplement the vertical gas extraction wells.

A vertical collection well spacing with a radius of influence of 125-150 feet within the center landfill area and 125' along the perimeter, consistent with the currently utilized landfill gas collection system, is currently anticipated unless a larger well spacing can be demonstrated in accordance with state and federal guidelines. Extraction wells will be interconnected through a wellhead piping system. This landfill gas extraction network will transport the landfill gas to a central location for processing at a landfill gas flare, gas-to-energy facility or other approved method of processing depending on the landfill gas quality. A minimum 6" solid HDPE pipe will be used. However, header pipes will be properly sized to accommodate the landfill gas quantity. The gas collection system shall be operated until the waste has stabilized enough to no longer produce methane quantities that exceed allowable concentrations in Section 811.311(a)(1-3).

The landfill gas collection piping system will be composed of HDPE or other material capable of resisting corrosion due to the landfill material and gas composition. HDPE and other materials also offer strength and flexibility which will withstand the effects of settlement to the system. Landfill gas piping may be installed above or below the final cover geomembrane, with initial installation typically occurring below the geomembrane and future replacement, if needed, occurring above the geomembrane. The well head assembly will be equipped to allow the monitoring and adjustment of landfill gas flow and the collection of landfill gas samples.

The gas header pipes will be sloped to drain condensate to either condensate driplegs within the Landfill waste or to condensate sumps located outside the waste boundaries and part of the perimeter gas header. Condensate sumps will be single-walled HDPE structures with the sump portion wrapped in GCL. Collected condensate will be pumped to the leachate tank through underground double-walled transmission piping. A sufficient number and locations of condensate sumps and driplegs will be established to ensure condensate management. Condensate that is collected will be stored and managed as leachate. Gas will not be directly discharged to the atmosphere without treatment or burning, in accordance with a permit issued pursuant to 35 Ill. Adm. 200-45.

Settlement will occur due to decomposition of the refuse. The design of the GCCS components include several features to account for this settlement. As detailed on **Drawing D26**, the extraction well heads will be connected to the LFG transmission piping via a flexible pipe or hose connection. This allows the LFG piping to accommodate changes in the orientation of the LFG transmission piping or LFG extraction well. Additionally, the LFG transmission piping within the Landfill waste boundary will be sloped at sufficient grades (at a minimum slope of six percent) so that reasonable amounts of differential and total settlement may occur without causing pipe breakage or disrupting the overall flow gradient of the LFG transmission piping. These slopes exceed the maximum differential settlement values determined in **Appendix J**.

Compliance with Siting Ordinance Conditions

In accordance with the conditions of the Siting Ordinance, the landfill owner/operator commits to installation of the landfill gas collection system, as permitted, in each cell, within the first three years of waste acceptance in any cell, or as otherwise needed to maintain BMPs at the landfill, whichever occurs first. The landfill gas collection system shall, at a minimum, follow BMPs for construction, installation, repair or alteration, and monitoring, at the time such activities take place. For example, current BMPs may include, but are not limited to:

1. Landfill gas collection on leachate sumps for odor control;
2. Early collection of landfill gas through horizontal or caisson wells;
3. Precision flow meter or equivalent at well head;
4. Surface emission monitoring; and
5. Liquid removal from vertical landfill gas wells, as necessary.

Necessary repairs to or replacement of any gas collection header piping that remains below the final cover geomembrane upon construction of the final cover will be performed by abandoning the affected piping in-place and installing replacement piping above the final cover geomembrane.

Geotechnical Analyses

Geotechnical analyses have been performed for the proposed design in order to verify that the liner and final cover will be stable during construction, operation, and following closure of the Landfill. The analyses demonstrate that the Landfill slopes will be stable and that the structural integrity of the bottom liner and final cover will be maintained over the life of the Landfill and beyond. Specifically, the following evaluations have been completed:

1. *Shear Strength Evaluation*. The stability of the proposed final cover system and bottom and sideslope liner and leachate collection system were evaluated to ensure the minimum factors of safety against failure (1.5 for static conditions and 1.3 for seismic conditions) are achieved.

2. *Foundation Evaluation*. Foundation evaluations analyzing the maximum foundation settlement, hydrostatic uplift, and foundation bearing capacity failure potential were conducted for the proposed Landfill.

3. *Liner / Leachate Collection System Evaluation.* This evaluation includes calculations analyzing the anchor trench design, wheel loading, and puncture resistance. These evaluations consider additional geosynthetic material considerations as to whether the proposed materials will function as required over the life of the proposed Landfill.

4. *Final Cover Evaluation.* This evaluation contains analyses which determine the maximum differential settlement of the waste, whether the geomembrane has the required strength to withstand the normal stresses imposed by the waste stabilization process, whether the final cover geocomposite and toe drains will remain free-draining, and the factor of safety against slope failure of the terrace berms on the final cover for static and seismic conditions.

5. *Additional Geosynthetic Strength and Protection Considerations*. These analyses include several calculations such as geomembrane strain, leachate pipe

deflection and crushing, wheel loading, puncture resistance, and final cover geocomposite transmissivity. These evaluations consider additional geosynthetic material considerations as to whether the proposed materials will function as required over the life of each Landfill design option.

Supporting documentation and calculations are provided in **Appendix J**. Geotechnical analyses have been performed under the direct supervision of a licensed professional engineer experienced in geotechnical engineering.

Geotechnical Analyses Design Parameters Summary

A summary of the material unit weights and shear strength values for the Landfill layers and geologic units is presented in **Table 2.3-2**. These values were calculated from laboratory test results that were completed as part of the hydrogeological investigation. These values are used in the geotechnical calculations in **Appendix J**.

Table 2.3-2
Zion Landfill – Site 2 North Expansion
Summary of Material Unit Weights and Shear Strength

Layer Description	Dry Unit Weight "γ_{dry}" (pcf)	Total Unit Weight "γ_{total}" (pcf)	Saturated Unit Weight "$\gamma_{saturated}$" (pcf)	Shear Strength Short-Term Conditions[1]: Cohesion c (psf)	Shear Strength Short-Term Conditions[1]: Friction Angle φ' (degrees)	Shear Strength Long-Term Conditions[2]: Cohesion c' (psf)	Shear Strength Long-Term Conditions[2]: Friction Angle φ' (degrees)
In Situ / Foundation Soils Beneath Landfill & Outside Landfill Footprint							
Wadsworth Till	118.4	136.6	137.8	1,465	11.8	1,000	14.3
Shallow Drift Aquifer[3]	104.8	123.3	129.8	-	-	-	-
Landfill Layers:							
Final Cover Soils[4]	106.7	121.5	130.3	1,465	11.8	0	34.3
Waste Fill[5]	75.0	75.0	75.0	0	33	0	30
LCS Granular Drainage Layer[6]	125.0	126.0	130.0	0	30	0	30
Low Permeable Earth Liner[4]	112.6	128.2	134.1	1,465	11.8	0	34.3

Notes:

1. Shear strength values for short-term conditions of the Wadsworth Till, Final Cover Soils, Low Permeable Earth Liner are derived from the unconsolidated-undrained triaxial shear strength Mohr circles (see attached figures). It is assumed these conditions occur during initial landfill cell development and interim waste fill heights / active landfill cell phase. A summary of the test results are presented in the attached Tables and the complete laboratory test results are provided in **Appendix I**. The Mohr circles are also provided in the attached pages.
2. Shear strength values for long-term conditions of the Final Cover Soils and Low Permeable Earth Liner are conservatively derived from the Mohr circles of the effective stress, consolidated-undrained triaxial shear strength tests. The long-term shear strength value assumed for the Wadsworth Till is derived from the Mohr circles of the total stress, consolidated-undrained triaxial shear strength tests. A summary of the test results are presented in the attached Tables and the complete laboratory test results are provided in **Appendix I**. The Mohr circles are also provided in the attached pages.
3. The Shallow Drift Aquifer, Lower Till, Basal Drift, and Bedrock units are significantly lower than the proposed landfill base and therefore were not considered in the geotechnical analyses.
4. The unit weights of the Final Cover Soils and the Low Permeable Earth Liner are derived from the results of Standard Proctor tests performed on the Wadsworth Till soils. It was assumed that the Final Cover Soils and Earth Liner Soils will be compacted to 90% and 95% of the Standard Proctor test results, respectively, and therefore the unit weights of the Final Cover Soils and Low Permeable Earth Liner are based on these corresponding values. A summary of the Standard Proctor test results are presented on Table 3 in the attached pages. The complete Standard Proctor laboratory test reports are provided in **Appendix I**. Modified Proctor testing was not analyzed for hydraulic conductivity testing or shear strength evaluations. In the event that Modified Proctors are intended to be used during construction, shear strength values should be evaluated prior to use to ensure that the strength parameters fall within the acceptable ranges identified within this Appendix. While direct comparisons cannot be made, 90% and 95% of the Standard Proctor (for the Final Cover Soil and Low Permeable Earth Liner, respectively) generally produce similar compactive efforts as 85% and 90% of the Modified Proctors, respectively. It should be noted that the unit weights of the Final Cover Soil and Low Permeable Earth Liner in the Site 2 North Expansion are as conservative as or more conservative than the values used for the Zion Site 2 East Expansion completed in 2011 by Weaver Boos Consultants, Inc.
5. The unit weight of the waste fill is based on an average value reported in published technical literature (see attached pages). The shear strength values of the waste fill are based on bilinear shear strength envelopes results for MSW waste in conventional landfills described in Eid et. al (2000). It should be noted that the unit weights and shear strength values of the Waste for the Site 2 North Expansion are as conservative as or more conservative than the values used for the Zion Site 2 East Expansion completed in 2011 by Weaver Boos Consultants, Inc.
6. The unit weights of the LCS Granular Drainage Layer are based on the unit weights of similar materials used at other landfills. It should be noted that the unit weights and shear strength values of the LCS granular drainage layer for the Site 2 North Expansion are as conservative as or more conservative than the values used for the Zion Site 2 East Expansion completed in 2011 by Weaver Boos Consultants, Inc.

Additionally, for all geotechnical analyses a seismic coefficient of 0.0461g for the Landfill site area was used. This value was obtained from the United States Geologic Survey (USGS)

Earthquake Hazards Program – National Seismic Hazard Mapping website. It represents a 10% or greater probability that the maximum horizontal acceleration in lithified earth material, will exceed 0.10g in 250 years.

Shear Strength Evaluations

Stability analyses were performed for the final cover and bottom liner and leachate collection systems in order to determine if the geometry and material properties of the proposed Landfill design are appropriate and will remain stable during static and seismic conditions.

Final Cover Stability

A final cover stability analysis was conducted to determine the range of acceptable peak shear strength parameters for the final cover system. Multiple combinations of friction angles and adhesions were evaluated to determine the minimum acceptable peak interface shear strength envelope to achieve stability of the final cover. The results of the analysis yielded factors of safety greater than 1.5 for static conditions and greater than 1.3 for seismic conditions. The supporting calculations are provided in **Appendix J.2-A**.

Bottom Liner and Leachate Collection System Stability Prior to Waste Placement

A liner and leachate collection system stability analysis was conducted to determine the range of acceptable shear strength parameters that provide a factor of safety against slope failure prior to waste placement. Multiple combinations of friction angles and adhesions were evaluated to determine the minimum acceptable interface shear strength envelope to achieve stability of the liner and leachate collection system prior to waste placement. The results of the analysis yielded factors of safety greater than 1.3 for static conditions and greater than 1.0 for seismic conditions. The supporting calculations are provided in **Appendix J.2-B**.

Bottom Liner and Leachate Collection System Stability After Waste Placement

A pseudo-seismic analysis was performed to determine the range of acceptable liner and leachate collection system shear strength parameters that provide a factor of safety against slope failure during construction/operation and closure periods and during seismic events.

Landfill Stages Analyzed and Modes of Failure

The stability of the Landfill was analyzed for two different landfill stages: complete landfill build-out / final landform and intermediate/operational buildout. The two landfill stages were analyzed using two modes of failure within the computer model SLIDE (a 2D Limit Equilibrium Slope Stability software program by Rocscience, Inc.) - translational (non-circular / block) failure and rotational (circular) failure. The translational failure mode was used to analyze the stability of the liner system along critical (weak) interfaces; and the rotational failure mode was used to analyze the stability of the waste mass and the foundation.

The stability analyses were performed for both short-term (unconsolidated / undrained) and long-term shear strength (consolidated / undrained) under static and seismic loading conditions. Long-term shear strength conditions will most likely occur following the complete build-out of the Landfill.

Results of the stability analyses are summarized in **Table 2.3-3**. The following results demonstrate that the Landfill design meets the requirements of 35 Ill. Admin. Code (35 IAC) 811.304, which states that all final slopes must achieve a minimum factor of safety of 1.5 for static conditions and a minimum factor of safety of 1.3 for seismic conditions. A more detailed discussion is provided in **Appendix J.2-C** that includes a discussion of the critical cross sections selected for analysis, the scenarios / conditions modeled for each cross section, and supporting model output files.

Table 2.3-3 Zion Landfill – Site 2 North Expansion Slope Stability Summary				
Analysis	Factors of Safety			
	Short-Term Shear Strength		Long-Term Shear Strength	
	Static	Seismic	Static	Seismic
Stability Cross Section A-A' – Horizontal Expansion (northern slope): Intermediate Buildout				
NonCircular / Liner Block Search	1.523	1.300		
Circular / Grid Search	1.709	1.332		
Stability Cross Section A-A' – Horizontal Expansion (northern slope) : Complete Buildout				
NonCircular / Liner Block Search	2.127	1.738	1.984	1.628
Circular / Grid Search	2.658	1.914	2.337	1.949
Stability Cross Section B-B' – Horizontal Expansion (eastern slope) : Intermediate Buildout				
NonCircular / Liner Block Search	1.549	1.320		
Circular / Grid Search	1.850	1.532		
Stability Cross Section B-B' – Horizontal Expansion (west slope) : Complete Buildout				
NonCircular / Liner Block Search	2.188	1.790	2.040	1.676
Circular / Grid Search	2.711	2.117	2.339	1.951
Stability Cross Section B-B' – Horizontal Expansion (east slope) : Complete Buildout				
NonCircular / Liner Block Search	2.128	1.742	1.982	1.629
Circular / Grid Search	2.623	2.042	2.340	1.953

Evaluation of Wadsworth Till During Rapid Drawdown of Detention Basin

Rapid drawdown conditions arise when submerged slopes experience a rapid reduction in water level. The reduction in water level removes the stabilizing force from the weight of the water and the pore pressure of the basin foundation material (Wadsworth Till) will be slow to dissipate. These scenarios will reduce the slope stability of the basin. This calculation is developed to identify the lowest factor of safety assuming that rapid drawdown of the detention basin occurs with the force of the fully constructed landfill behind it (worst case scenario).

Landfill Stages Analyzed and Modes of Failure

Stability of the landfill was analyzed during final buildout (following final cover placement) conditions and during rapid drawdown conditions of the detention basin. There are three methods of rapid drawdown analyses in SLIDE with two of the methods having different interpolation methods which relate the undrained strength of the soil (after drawdown) to the pre-drawdown strength.

The stability of the waste mass and foundation after rapid drawdown was evaluated within the SLIDE model using the rotational (circular) failure. This uses a grid search to find the most critical circular failure surfaces within the waste mass and foundation. The grid search was performed in an iterative manner by the SLIDE model user. Each time the user adjusted / fine-tuned the grid to the point where the model generated the absolute lowest factor of safety.

Results of the stability analyses are summarized in **Table 2.3-4**. A more detailed discussion is provided in **Appendix J.2-D** that includes a discussion of the critical cross section selected for analysis, the scenarios / condition modeled for cross section, and supporting model output files.

Table 2.3-4 Zion Landfill – Site 2 North Expansion Rapid Drawdown Conditions		
Analysis (Interpolation Method)	**Factors of Safety**	
	Short-Term Shear Strength	
	Seismic (>1.3)	**Static (>1.5)**
Stability Cross Section A-A' – Horizontal Expansion (northern slope) : Complete Buildout		
Duncan, Wright and Wong (VandenBerge, Wright)	1.951	2.657
Duncan, Wright and Wong (Duncan, Wright and Wong)	1.950	2.655
Lowe and Karafiath (VandenBerge, Wright)	2.076	2.771
Lowe and Karafiath (Duncan, Wright and Wong)	2.084	2.728
Army Corp of Engineers (NA)	1.862	2.584

Landfill Foundation Evaluations

Foundation evaluation calculations were performed for the proposed Landfill. These analyses verify the Landfill foundation is will remain stable during excavation, capable of supporting the weight of overlying operating equipment and waste, will maintain stability in seismic situations, and that the leachate collection system will continue to function as intended with foundation settlement.

Hydrostatic Uplift

The stability against hydrostatic uplift of the excavation during construction activities was estimated. The potentiometric levels of the Wadsworth Till were assumed to be 5-feet below the existing ground surface and in contact with the top of the granular drainage layer along the liner base and side slopes. This represents the worst-case scenario for groundwater at the site. The maximum excavation depth will occur in Cell 11 and be approximately 60 feet.

The hydrostatic uplift under these conditions was determined to be 3,744 psf. Based on the worst anticipated conditions at the site and a minimum factor of safety of 1.2, it was determined that hydrostatic uplift will be counteracted once waste is placed in the horizontal expansion to an initial height of approximately 49.2 feet. Before the waste reaches this height, stability will be achieved by dewatering of the Wadsworth Till using the gradient control system. See **Appendix J.3-A** for the calculation.

Foundation Settlement

As the Landfill is constructed, the weight of the waste will cause the low permeable earth liner and the Wadsworth Till foundation to consolidate slightly. Consolidation is the settlement due to the reduction of void space. Differential settlement calculations were performed to verify that the leachate collection system will still drain after the Landfill foundation settles (refer to **Appendix J.3-B**).

It was determined that the slopes of the leachate collection system pipes exceed the maximum anticipated differential settlement that will occur, allowing the pipes to remain free-draining. Although the slope of the proposed leachate collection system may change over time due to settlement, the resulting slopes will continue to allow for drainage and meet performance requirements.

Bearing Capacity Foundation Analysis

Bearing capacity analyses were performed to demonstrate that the foundation materials beneath the proposed Landfill exhibit sufficient strength to support anticipated loads. The most critical location across the Landfill base was analyzed at the maximum waste height for the proposed Landfill, which was found to be in Cell 7 in the vertical expansion area. Terzaghi's bearing capacity equation was used to calculate the ultimate bearing capacity using engineering properties of the geologic and engineered fill materials. The factor of safety is the ratio of the ultimate bearing capacity to the overburden pressures expected to act on the foundation.

The results of the analysis yielded factors of safety greater than or equal to 2.0 under static conditions and greater than 1.8 under seismic conditions. The supporting calculations are provided in **Appendix J.3-C**. The calculations contained in **Appendix J.3-C** also demonstrate that the bedding materials of the leachate collection system possess the structural strength to support the maximum loads imposed by the overlying materials and landfill equipment.

Liner/Leachate Collection System Evaluations

Liner/leachate collection system evaluations were performed for the proposed Landfill design to ensure the geosynthetic materials will continue to function as required over the life of the Landfill design.

Anchor Trench Design

The geosynthetics to be used as part of the proposed Landfill design provide sufficient friction angles that they are anticipated to hold themselves in place after installation. However, anchor trenches are proposed to be used along the perimeter of the waste boundary to bury the edge of geosynthetic materials, in order to protect the edges and provide protection from wind uplift. The anchor trench design was evaluated based on the strength properties of the geomembranes.

It was found that the depth of the anchor trench should not exceed 5.2-feet in order to provide holding capacity against the self-weight of the geomembrane, while allowing pull-out of the geomembrane at loads approaching the ultimate material strength of the geomembrane, which minimizes the potential for tearing. The proposed design depth for each anchor trench is 3-feet and therefore the anchor trench design is considered appropriate. See **Appendix J.4-A** for detailed calculations.

Wheel Loading on Geomembrane

The wheel loading due to construction and compaction equipment operating on the initial lift of waste and acting on the geomembrane was evaluated. The wheel loading was analyzed using the Caterpillar 836K Compactor and the product information of a 60-mil HDPE geomembrane. A resulting factor of safety of 56.6 was determined, which indicates that the geomembrane can withstand the wheel loading of the construction equipment without degradation in material quality. See **Appendix J.4-B** for supporting calculations.

Puncture Resistance of Geosynthetics

The geosynthetics in the composite liner and leachate collection systems (consisting of the 60-mil HDPE geomembrane, 10-oz/yd^2 non-woven geotextile filter, and 12-oz/yd^2 non-woven geotextile cushion) were analyzed to demonstrate they are an appropriate thickness to resist puncture from the adjacent aggregate material in the horizontal expansion. The geosynthetics were analyzed at the maximum waste thickness of approximately 198 feet in the horizontal expansion area, based on an aggregate shape being sub-rounded to sub-angular and an assumed safety factor of 2.0.

Based on these parameters, the maximum acceptable average diameter for aggregate to resist puncture of the geotextiles and the aggregate material diameters specified in the CQA Plan (see **Appendix O**) is as follows:

1. For the 10-oz/yd^2 geotextile filter overlying the granular drainage layer: 2.25 inches. This is greater than the assumed maximum granular drainage layer particle diameter of 1.0 inches.

2. For the 10-oz/yd^2 geotextile overlying the leachate collection system trench coarse aggregate in the leachate collection trenches: 1.74 inches. This is greater than the assumed maximum leachate collection system coarse aggregate diameter of 1.5 inches.

3. For the 12-oz/yd^2 geotextile underlying the granular drainage layer across the base of the horizontal expansion: 2.40 inches. This is greater than the assumed maximum granular drainage layer particle diameter of 1.0 inches.

4. For the 12-oz/yd^2 geotextile overlying the 60-mil HDPE geomembrane and underlying the leachate collection system trench coarse aggregate in the leachate collection trenches: 1.86 inches. This is greater than the assumed maximum leachate collection system coarse aggregate diameter of 1.5 inches.

See **Appendix J.4-C** for supporting calculations.

To demonstrate puncture resistance of the geomembrane underlying the leachate collection system in the proposed horizontal expansion and in the existing constructed areas over which the vertical expansion will be constructed, a series of laboratory (including bench-scale and large-scale) evaluations were conducted using the same material configuration as what is proposed. The laboratory evaluation was originally conducted for the Orchard Hills Landfill, located in Davis Junction, Illinois, to replicate the puncture resistance of the in-place LCS geosynthetics[1]. Therefore, the laboratory report is being used to demonstrate that the proposed LCS pipe trench configuration in the proposed horizontal and vertical expansions of Zion Landfill will not puncture the 60-mil textured geomembrane. This approach was utilized because necessary coefficients to complete the calculation were not available in

1 Zion Landfill, Inc. and Orchard Hills Landfill were historically under the common ownership of Advanced Disposal Services until October 29, 2020. The prior evaluation conducted for Orchard Hills Landfill was completed in advance of that date and provided to the Landfill team for use in this application.

source literature for the specific combination of aggregate materials and geotextiles that will be constructed in the horizontal expansion and have been constructed at the existing Landfill. The laboratory evaluations demonstrated that materials utilized in construction of the existing leachate collection system did not result in puncture under the loading conditions that will be present in the proposed horizontal and vertical expansions. The laboratory evaluations are provided in **Appendix J.4-C**.

Final Cover Evaluations

The final cover was evaluated to ensure adequate drainage will be maintained and that the geomembrane and terrace berms will have the appropriate strength and geometry to support stability throughout the life of the Landfill.

Waste Settlement

This calculation determines the maximum settlement that is anticipated to occur within the waste mass at multiple locations to ensure that the plateau area of the final cover will maintain positive drainage after settlement occurs. For the purpose of this analysis, the maximum differential settlement is determined for the plateau (top) of the Landfill, as it is designed with the minimum slope of all final cover areas. The maximum potential differential settlement within the waste mass is added to the calculated differential settlement within the foundation to determine whether the slopes of the final cover are appropriate.

Five analysis points were determined to provide the maximum potential settlement along the plateau in the horizontal and vertical expansions. These five points represent the maximum and minimum waste thickness along the plateau in the horizontal and vertical expansions, and the maximum waste thickness over an LCS pipe along the plateau in the vertical expansion. The maximum waste thickness for the proposed Landfill design will exist in Cell 7 with an approximate material thickness of 206 feet. The minimum thickness will exist between Cells 7 and 1 and Cells 9 and 1 with an approximate waste thickness of 136.7 feet.

The maximum differential settlement across the proposed Landfill plateau is calculated to be approximately 5.04 percent (4.15 percent + 0.89 percent from the foundation soil settlement). The design slope of the plateau is 10H:1V (approximately 5.71 degrees). Therefore, the resulting slope after differential settlement is anticipated to be approximately 0.67 degrees (approximately 1.17 percent). This slope is acceptable, as the final cover will maintain positive drainage. See **Appendix J.5-A** for additional information.

As an additional safeguard, the Landfill final cover will be periodically monitored, and maintenance will be performed as necessary. Final cover inspection and maintenance will be performed in accordance with the facility's post-closure care plan contained in **Section 2.9** of this Application.

Final Cover Geomembrane Strain

The final cover geomembrane was evaluated to see if it possesses the required strength to withstand the normal stresses imposed by the waste stabilization process. A textured LLDPE geomembrane is analyzed, which will be utilized in all areas with slopes greater than 10H:1V. The allowable strain for the final cover geomembrane was determined to be 30 percent, which is based on manufacturer's specifications.

AutoCAD Civil3D 2018 (AutoCAD) was used to determine the maximum differential settlement dimensions that occur based on the initial design final cover slopes and maximum 30 percent allowable strain. The maximum allowable strain was then calculated and it was determined that the geomembrane can accommodate a differential settlement of 64 percent for 4H:1V slopes before reaching its allowable strain limit. A differential settlement of 64 percent far exceeds the maximum differential settlement that was calculated for the final cover due to waste settlement (please refer to **Appendix J.5-A**). However, the final cover will be routinely observed for differential settlement. The geomembrane will be evaluated for over-stressing in locations where differential settlement exceeds 64 percent. See **Appendix J.5-B** for the calculation.

Final Cover Geocomposite Transmissivity

The final cover geocomposite was evaluated to see if it will remain free-draining based on stormwater impingement rates through the final cover. A 6-oz/yd^2 double-sided geocomposite drainage layer was analyzed over the minimum final landform slope of 10H:1V. The maximum daily peak head from the HELP model in Appendix K was used to estimate the amount of head on the final cover geocomposite. Using this information, the field geocomposite flow rate was determined to be 2.6x10^{-5} ft^3/sec. This value is greater than the maximum flow rather through the overlying final cover soils, which was determined to be 1.4x10^{-6} ft^3/sec, and therefore the final cover geocomposite will be free-draining. See **Appendix J.5-C** for the calculation.

Toe Drain Capacity

The proposed 4-inch toe drains (discharge pipes) were evaluated to ensure they are adequately sized to drain water that percolates through the final cover and is transmitted downslope through the 6-oz/yd^2 geocomposite. The toe drains are designed with a 200-foot spacing interval. The maximum flow rate of the water converging on the toe drain from the geocomposite was determined to be 0.20 ft^3/sec across the 200-ft wide spacing. The maximum flow rate for the 4-inch pipes at full capacity was determined to be 0.39 ft^3/sec. Based on these values it was determined the proposed toe drain spacing and sizing will pass a flow rate of water greater than the maximum flow rate of water discharging from the geocomposite and entering the toe drain. See **Appendix J.5-D** for the calculation.

Terrace Berms

The proposed terrace berm configuration was evaluated to determine the factor of safety against slope failure for static and seismic conditions. The terrace berms for the proposed final cover will typically have a 2H:1V slope and will rise approximately 2.0-feet above the highest common point of the slope. In the analysis it was assumed that the berms will be constructed from the same materials as the final cover soils.

The results of the analysis can be seen in **Table 2.3-5** below. Based on this analysis, the terrace berms have been designed to meet the required factor of safety for both static (at least 1.5) and seismic conditions (at least 1.3).

Table 2.3-5 Terrace Berms Factor of Safety		
Analysis	**Short-term Conditions**	**Long-term Conditions**
Static	26.6	2.73
Seismic	22.5	2.20

See **Appendix J.5-E** for an in-depth analysis and calculations.

Design Period

The incremental capacity of the proposed Expansion will begin to be filled at the end of the operating life of the existing Landfill, which is currently estimated to be in 2027. The estimated operating life of the landfill may vary due to changes in incoming waste volume and waste compaction rates but is estimated to continue through approximately 2044. The Landfill will be constructed and operate to perform safely throughout and after the entire design period, including a minimum of thirty (30) year of post-closure. Additional information and calculations of the operating life are provided in **Appendix N** of this Application

Construction Phasing

The Expansion consists of approximately seven cells (Cells 11-17) in the horizontal expansion and a vertical expansion over Cells 6, 7, and 9 of the existing Landfill. The Landfill will be developed starting with Cell 11 on the southern portion of the facility and progressing sequentially northward. The vertical expansion will be filled concurrently with Cells 11 and 12. It is noted that cells may be constructed incrementally (portions of a cell) based on the waste throughput needs at the time of construction.

Following the construction of each Landfill cell, or portion thereof, operating permits must be granted from the IEPA prior to waste acceptance. In the event that landfill regulations change prior to cell construction, the Landfill design, technology, or construction technique will be modified as necessary to be in compliance with the new regulations. Once active, each cell of the Facility will generally be sequentially filled as shown in **Drawings D30-D37**. Cell boundaries are depicted on **Drawings D7-D10**, and each phase of cell construction is shown in **Drawings D30-D37**. The actual size and configuration of each phase will depend upon a number of factors, including waste volumes, stormwater routing, permitting, etc. As a result, the phasing plan illustrated in **Drawings D30-D37** is considered to be preliminary; actual phasing could vary from that shown.

The site development provides for sequential construction, filling, and closure of parts of the proposed Landfill throughout the operating life. The final cover will be placed contemporaneously with the Landfill development when possible. This will be accomplished by constructing the final cover in phases as portions of the Landfill achieve final grade. Construction of the stormwater features will be developed concurrently with development to ensure adequate stormwater controls are provided.

The phasing of Landfill development will have a number of important benefits that enhance the environmental safety of the facility:

1. Construction will occur in a planned, orderly manner.

2. Adequate disposal areas will be constructed to handle incoming waste flows.

3. The size of "active" disposal areas will be minimized, reducing the quantities of leachate generated and the potential for nuisance impacts (e.g., dust, odors) to develop.

4. Completed sections of the Landfill may be capped with final cover as they reach final grades, reducing the quantities of leachate generated.

Estimated Phasing Schedule

Table 2.3-6 summarizes the approximate size and the projected year of construction, filling, and closure of the waste disposal areas comprising the proposed Landfill. Note that filling simultaneously occurs in multiple phases as phases cannot be filled to final grade until adjacent cells approach final grade. The anticipated phasing is dependent upon variable conditions such as incoming waste volumes and weather conditions. The phasing schedule assumes that cell construction will occur in the spring, summer, or fall preceding the year when the capacity will be needed. Placement of final cover and establishment of permanent vegetative cover will occur as soon as practicable. Estimated closure dates are expected to be representative of side-slope closure periods, with plateau areas being closed in later years when final grades are achieved and waste settlement has occurred.

Considering all of the various influences on construction schedules, including weather and fill volumes, the estimated sequence of construction represents the phasing envisioned at the time of design. Adjustments and modifications are anticipated considering the size, complexity and life of this project, and the design of the Landfill provides the flexibility to adjust phasing as necessary.

Table 2.3-6
Approximate Phasing of Cell Development

Phase	Phase Description	Approx. Year of Construction	Approx. Year of Filling	Approx. Year of Side-Slope Closure
A	Cell 11	2026	2027-2030	2031
B	Cell 12	2027	2028-2033	2034
C	Cell 13	2028	2029-2035	2036
D	Cell 14	2032	2033-2038	2039
E	Cell 15	2034	2035-2040	2041
F	Cell 16	2037	2038-2042	2043
G	Cell 17	2039	2040-2044	2045

1. Years of Construction, Filling, and Closure are approximate.
2. Years of Closure reference expected year of side-slope closure for each cell. Plateau areas will be closed in later years when final grades are achieved and waste settlement has occurred.
3. Phasing Plan may differ from what is shown.
4. The vertical expansion will progressively be filled as Cells 11 and 12 approach final grades.

Cell Development

Initially, Cell 11 of the Landfill will begin to be filled; this is the first area of construction. Concurrent with Cell 11 construction and prior to operation of Cell 11, the following features and structures will be developed or installed:

- New leachate storage tank with secondary containment and leachate forcemain to the leachate storage tank;
- Perimeter access road along at least the west side of the Expansion and providing access through the leachate loadout, ancillary northern entrance, and northern maintenance building; and
- New Stormwater Basin 8 and corresponding perimeter drainage ditches to convey stormwater to the basin.

Construction will continue such that each phase and cell will generally be filled to grade so that final cover may be applied as landfilling activities continue, as shown in **Drawings D30-D37**. If the surface of a fill area has been left inactive for a period greater than 60 days, the area will be covered with one foot of compacted clean soil (intermediate cover). The cover will be sloped to promote drainage and will minimize infiltration into the fill.

No Landfill areas will be developed without adequate stormwater management controls. It is noted that because the stormwater controls have been designed to accommodate the fully developed Landfill, they are also sufficiently sized to handle interim conditions. However, additional temporary measures will be incorporated to divert stormwater away from active landfilling and liner construction areas. Prior to the start of liner construction, diversion berms and drainage ditches will be developed to prevent runoff from impacting construction areas. These perimeter features will intercept the runoff from undisturbed areas before it reaches construction areas.

Construction of subsequent areas will be phased to ensure that adequate Landfill capacity is continuously available. Once construction of a new area is complete and the operating authorization from the IEPA has been received, waste disposal will be diverted from the area currently receiving waste to the newly developed area to establish a protective layer of waste.

The following is a summary of the main points regarding the sequence of construction:

1. Landfill construction will be scheduled to the greatest extent possible so that the initial filling of each area will occur prior to winter.
2. Once constructed and operating authorization has been received from the IEPA, the waste disposal operations will be transferred to the newly constructed cell phase as soon as practical to cover and protect the liner.
3. Only one active face will be utilized during operation unless conditions arise that require more than one active face to be operated at a time. An example of such a condition is when a phase is “topped out” to reach its final permitted grades.
4. Any previously active face or waste disposal area that is inactive for more than 60 days will be covered with intermediate cover consisting of at least one foot of clean compacted soil.
5. Construction of the final cover will commence as soon as practical.
6. Stormwater management controls and monitoring systems for groundwater and landfill gas required for each area will be developed in advance of waste filling and expanded as necessary as filling progresses.

Groundwater Seepage

Excessive groundwater seepage in and around excavation areas during construction can result in inadequate fill subgrade conditions (i.e. too soft to allow the first lift of Compacted Foundation Fill or Earth Liner to be compacted to the specified density), and/or can result in excessive hydrostatic uplift pressures on the completed liner system.

The CQA Officer or designate CQA Officer-in-Absentia shall observe excavations and fill subgrades for evidence of excessive groundwater seepage and notify the Contractor and the Design Engineer in the event that excessive seepage is noted. In such areas, an underdrain collection system will be constructed prior to continuing with construction. Typical undrain collection system details are shown in **Drawing D15**, **D16** and **D18**. Groundwater will be transported via the underdrain control system to sumps which will be constructed similar to those constructed above the liner.

The underdrain collection system will be pumped only during construction and until the placement of waste in the cells results in a fill elevation that counteracts the potential for hydrostatic uplift of the liner system, as calculated in **Appendix J.3-A**. After waste filling has reached the necessary elevation in the cell, the underdrain collection system sump will be shut off, allowing the soil to re-saturate. No other monitoring or abandonment activities will be required for the underdrain collection system once the sump is shut off.

Initial Filling Sequence

After receipt of the operating authorization, waste filling will initiate, and select waste will be placed over the leachate collection drainage layer. The initial waste lift will be placed approximately 5 to 10 feet thick to cover the entire floor. Select fill will be placed against the sidewalls as equipment access allows. The initial waste and select fill layers will serve as a protective and insulating layer over the leachate collection system and synthetic liner. Daily (or intermediate) cover will be placed over the initial lift of waste to serve as a working surface. Subsequent lifts of waste will be covered at the end of each day with daily cover.

Seasonal Construction and Filling Considerations

The anticipated sequence of the Landfill construction and filling is dependent upon variable conditions such as incoming waste volumes and weather conditions. Therefore, typical seasonal conditions and the corresponding construction activities most suited to the temperature and precipitation associated with these seasons have been assumed.

The construction of the liner system and leachate collection system will generally take place in the drier late spring and summer, and possibly during early months of fall. However, if weather permits, construction may occur outside these seasons.

Daily cover placement, haul road construction, fill placement and other necessary activities will take place throughout the year as needed. Construction materials such as pipe, geotextile, and processed gravel for the leachate collection system may be stockpiled on-site to be ready for placement at all times. The proposed sequence of construction will allow for orderly construction and minimize the periods in which there is either a lack or an excess of manpower and equipment.

Placement of Final Cover

Construction of the final cover is recognized to have a direct influence on the amount of leachate generated. Therefore, placement of the final compacted cohesive soil cover will take place as soon as practical. Final cover will be constructed in phases. The compacted cohesive soil final cover will be covered with a low-permeability layer consisting of a 40-mil LLDPE geomembrane overlain by a double-sided geocomposite drainage net and protective soils as shown on **Drawing D15**. The top 6 inches of the protective layer will be capable of supporting vegetation such as grass for erosion protection. The objective will be to establish the stabilized final surface as quickly as possible after the filling has been completed in a particular area.

Material Balance

Soil from future cell excavations, sediment basin construction, and additional borrow areas will be used to meet the needs for daily and intermediate cover, and for construction of the bottom liner, final cover and other engineered features as documented in **Appendix N**. It is anticipated that aggregates for the leachate drainage and collection systems will be obtained from approved off-site sources. The development, operation, and closure of the Landfill will produce a surplus of 2,353,277 yd^3. Surplus soil will not be stockpiled or distributed over closed areas of the Landfill; off-site uses of the soil or off-site stockpile locations will instead be identified through the Landfill's operating life.

It is anticipated that soil for the Landfill development will primarily be derived from site excavations that satisfy the CQA requirements. Any material from offsite sources will comply with all the applicable CQA requirements.

During excavation, material types will be identified and segregated. Excavated materials meeting specifications for clay liner and cover construction will be directly hauled to the area of construction or stockpiled near the areas intended for utilization. In accordance with the conditions of the Siting Ordinance, soil or excavation materials shall not be stockpiled within the Site 2 North Expansion area above elevation 890 feet, and shall only be stockpiled within (not outside) the berm area surrounding the Site 2 North Expansion, except as needed for construction of berms and, to the extent outside the permitted boundary, in compliance with the zoning ordinance. In order to reduce the amount of stockpiling, daily and intermediate cover will be taken as needed from excavation areas.

ATTACHMENT 3
US EPA Guidance for Evaluating Landfill Gas Emissions from Closed or Abandoned Facilities
Section 5

APTIM

United States
Environmental Protection
Agency

EPA-600/R-05/123a
September 2005

GUIDANCE FOR EVALUATING LANDFILL GAS EMISSIONS FROM CLOSED OR ABANDONED FACILITIES

EPA-600/R-05/123a
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GUIDANCE FOR EVALUATING LANDFILL GAS EMISSIONS FROM CLOSED OR ABANDONED FACILITIES

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5. Landfill Gas Collection and Control Systems

Control of co-disposal landfill air emissions requires both effective collection of the LFG and effective destruction of organics in the collected gas. Due to the variability of site-specific factors that affect LFG generation and collection, a wide variety of collection systems are possible. These systems may include active collection wells (both vertical and horizontal), passive collection wells, and gas interception trenches. Control systems typically used include open flares and enclosed flares. Other control systems such as internal combustion engines (ICEs) and gas turbines are used for energy recovery in the production of electric power for resale. These types of energy recovery control systems are typically used at active MSW landfills where a portion of the landfill is subject to a CERCLA remedial action. This chapter covers the general concepts of collection and control systems used at the majority of closed or abandoned landfill sites.

5.1 Landfill Gas Collection Systems

The following discussion from U.S. EPA (1991) provides an overview of gas collection techniques. In addition, Appendix E of U.S. EPA (1999b) provides a summary of the design plan requirements for all collection systems subject to the CAA NSPS or EG.

Landfill collection systems can be categorized into two basic types: active systems and passive systems. Active collection systems employ mechanical blowers or compressors to provide a pressure gradient in order to extract the LFG. Passive collection systems rely on the natural pressure gradient (i.e., internal landfill pressure created due to LFG generation) or concentration gradients to convey the LFG to the atmosphere or to a control system.

An active landfill gas collection system consists of vertically or horizontally installed landfill gas collection wells. The well is designed and constructed so as to prevent air infiltration into the well intake screen area to minimize surface atmospheric air infiltration into the landfill. At the wellhead, each well is connected to the next wellhead by a well header pipe and so on until all headers gathering pipe has been connected to all wells. If there is more than one header pipe they are finally connected to a one main large diameter pipe. This one large diameter main pipe is then connected to a knock out receiver (pot) that removes liquid water condensate. The pipe coming out of the knock out receiver is then connected to the intake pipe of the landfill gas blower or compressor. The out going pipe from the blower is then finally connected to the flare stack or candle stick burner intake.

If the collected gas is to be released directly to the atmosphere without combustion, then vertical pipes with gooseneck top are normally installed at a regular intervals along each header pipe to vent landfill gas to the atmosphere. This type of landfill gas collection is known as a passive gas collection system.

Based on theoretical evaluations, well-designed active collection systems are considered the most effective means of gas collection. Generally, passive collection systems have much lower collection efficiency since they rely on natural pressure or concentration gradients as a driving force for gas flow rather than a stronger, mechanically-induced pressure gradient. A passive system, however, can be nearly equivalent in collection efficiency to an active system if the landfill design includes synthetic liners on the top, bottom, and sides of the landfill.

Active collection systems can be further categorized into two types: vertical well systems and horizontal trench systems. Both types of systems are discussed in Section 5.1.1. Passive systems are discussed in Section 5.1.2. The type of collection system employed often depends on the landfill characteristics and landfill operating practices. For example, if a landfill employs a layer-by-layer landfilling method (as compared to cell-by-cell methods), an active horizontal trench collection system may be preferred over an active vertical well collection system due to the ease of collection system installation.

5.1.1 Active Collection Systems

Active collection systems employ mechanical blowers or compressors to create a pressure gradient and extract the LFG. Active collection systems consist of two major components:

- Gas extraction wells and/or trenches and
- Gas moving equipment (e.g., piping and blowers).

Gas extraction wells may be installed in the landfill refuse or along the landfill perimeter. For a landfill that is actively accepting waste, wells are generally installed in the capped sections. Additional wells are installed as more refuse is accumulated.

The wells consist of a drilled excavation 12 to 36 in. in diameter. A 2 to 6 in. diameter pipe—polyvinyl chloride (PVC), high-density polyethylene (HDPE), stainless steel, or galvanized iron—is placed in the well, and the well is filled with 1-in. diameter or larger, crushed stone. The pipe is perforated in the area where gas is to be collected but solid near the surface to prevent air infiltration. A typical extraction well is shown in Figure 5-1.

In unlined landfills, gas extraction wells are usually drilled to the depth of the groundwater table or to the base of the landfill, whichever is less. In lined landfills, wells are typically drilled to only 75 percent of the landfill depth to avoid damaging the liner system. Typical well depths range from 20 to 50 feet but may exceed 100 feet. The spacing between gas extraction wells depends on the landfill characteristics (e.g., type of waste, degree of waste compaction, LFG generation rate, etc.) and the magnitude of pressure gradient applied by the blower or compressor. Typical well spacing ranges from 50 to 300 feet.

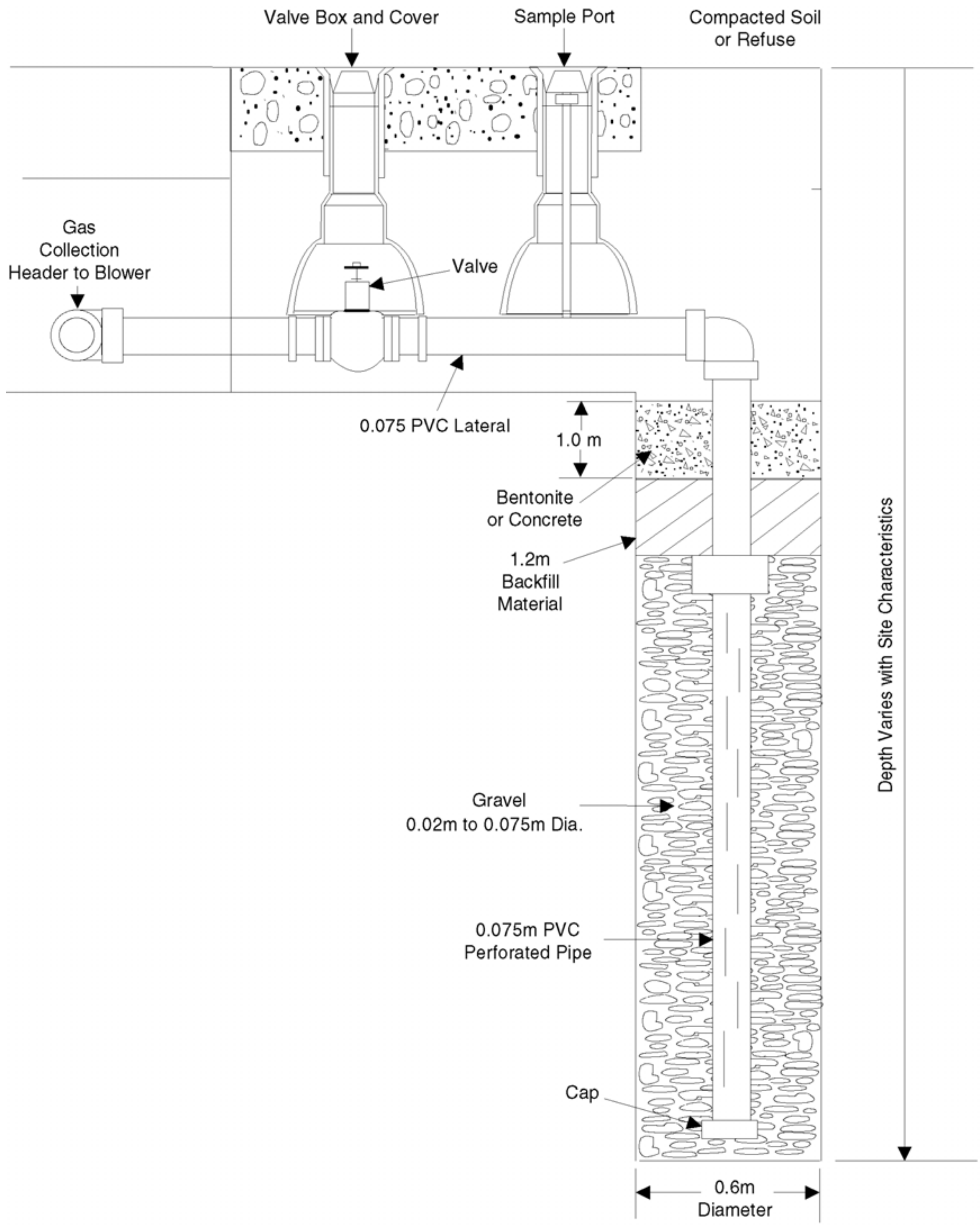


Figure 5-1. Gas Extraction Well Head Assembly.

Trenches may be installed instead of or in combination with wells to collect the LFG. The trenches can be vertical or horizontal at or near the base of the landfill. A vertical trench is illustrated in Figure 5-2. A vertical trench is constructed in much the same manner as a vertical well, except that it extends to the surface along one dimension of the landfill. Horizontal trenches are installed within a landfill cell as each layer of waste is applied. This allows for gas collection as soon as possible after gas generation begins and avoids the need for above-ground piping which can interfere with landfill maintenance equipment. A horizontal trench is illustrated in Figure 5-3.

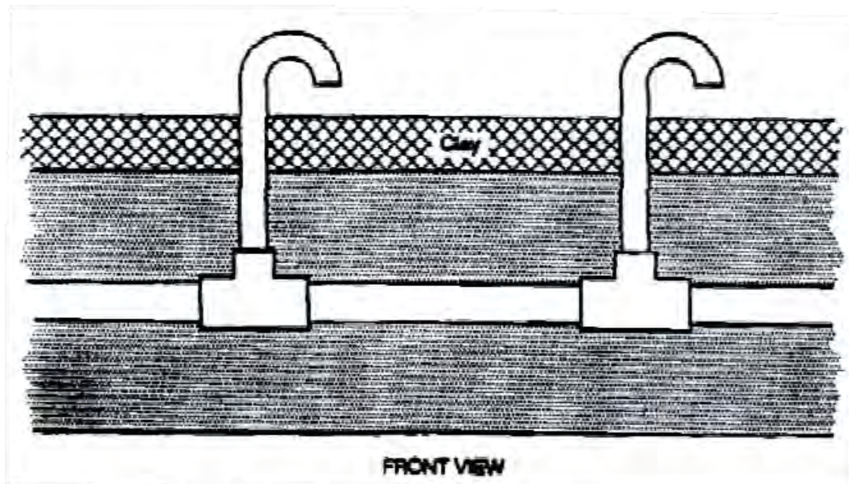


Figure 5-2. Vertical Trench for Active Collection System.

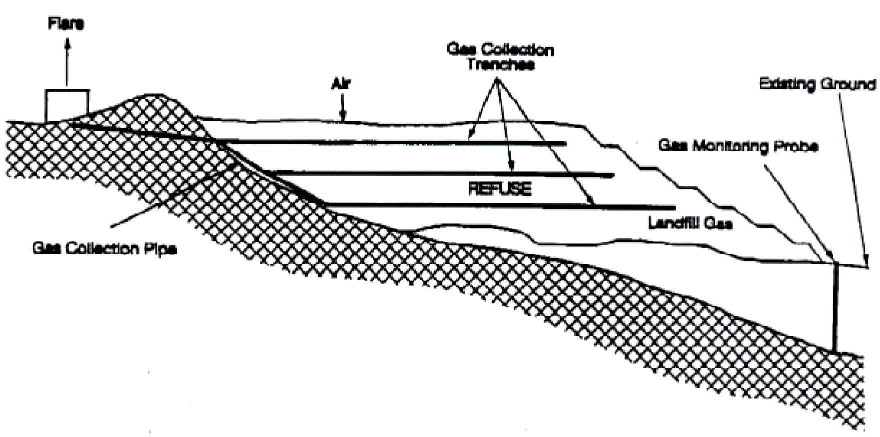


Figure 5-3. Horizontal Trench Collection System.

A gas collection header system conveys the flow of collected LFG from the well or trench to the facility housing the blower or compressor. A typical header pipe is made of PVC or polyethylene and is 6 to 24 inches in diameter.

At SFL sites, the collected LFG is conveyed through the header system by a blower. The size and type of blower depends on total gas flow rate, total system pressure drop, and vacuum requirements. For systems requiring only a small vacuum (up to 40 inches of water), sites often use centrifugal blowers, which offer the advantage of easy throttling throughout their operating range. These blowers can accommodate total system pressure drops of up to 50 inches of water and can transport high flow rates (100 to 100,000 cfm). For lower flow rates and higher pressures, regenerative (combination of axial and centrifugal) blowers are often used.

5.1.2 Passive Collection Systems

As indicated above, passive collection systems rely solely on natural pressure or concentration gradients in the landfill to capture LFG. Like active systems, passive collection systems use extraction wells to collect LFG. The construction of passive collection wells is similar to that of active wells which is illustrated in Figure 5-1.

The well construction for passive systems is much less critical than for active systems primarily because the collection well is under positive pressure and air infiltration is not a concern. Additionally, elaborate well head assemblies are not required because monitoring and adjustment is not necessary. However, it is important that a good seal be provided around the passive well when synthetic cover liners are used. Either a boot type seal, flange type seal, concrete mooring, or other sealing technique is typically used at each well location to maintain the integrity of the synthetic liner.

5.1.3 Effectiveness of Landfill Gas Collection

The effectiveness of an active landfill gas collection system depends greatly on the design and operation of the system. From the perspective of air emission control, an effective active collection system design would include the following attributes:

- Gas moving equipment capable of handling the maximum landfill gas generation rate,
- Collection wells and trenches configured such that landfill gas is effectively collected from all areas of the landfill, and
- Design provisions for monitoring and adjusting the operation of individual extraction wells and trenches.

An effective passive landfill gas collection system would also include a collection well or trench configuration that effectively collects LFG from all areas of the landfill. The efficiency of a passive collection system would also greatly depend on good containment of the LFG. An example of good containment would be synthetic liners on the top, sides, and bottom of the landfill.

The first criteria that should be satisfied for an active system is gas moving equipment capable of handling the maximum LFG generation rate; blowers and header pipes need to be sized to handle the maximum LFG generation rate. In addition, collection header pipes should also be sized to minimize pressure drop.

Each extraction well or trench has a zone of influence within which LFG can be effectively collected. The zone of influence of an extraction well or trench is defined as the distance from the well center to a point in the landfill where the pressure gradient applied by the blower approaches zero. The zone of influence determines the spacing between extraction wells or location of trenches since an effective collection system covers the entire area of the landfill. The zones (or radii) of influence for gas extraction wells are illustrated in Figure 5-4.

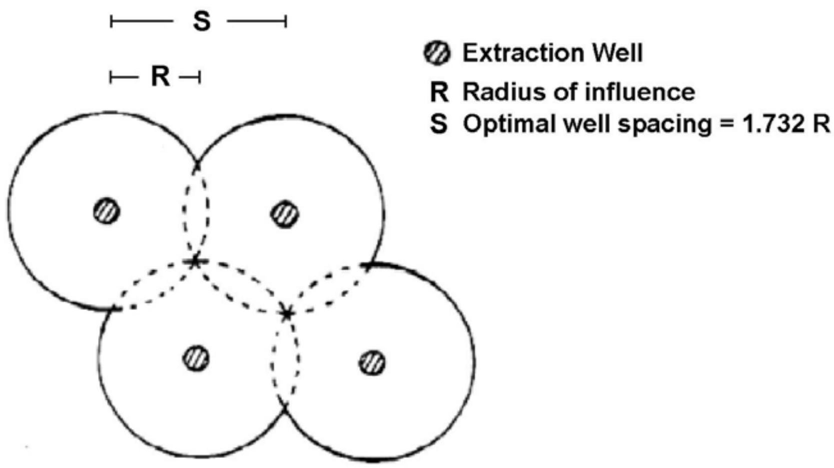


Figure 5-4. Zones of Influence for Gas Extraction Wells.

The spacing between extraction wells depends on the depth of the landfill, the magnitude of the pressure gradient applied by the blower, type of waste, degree of compaction of waste, and moisture content of gas. For perimeter extraction wells, additional variables such as the outside soil type, permeability of the soil, moisture content of the soil, and stratigraphy should be considered.

The desired method for determining effective well spacing at a specific landfill is the use of field measurement data. EPA Reference Method 2E can be used to determine the average stabilized radius of influence for both perimeter wells and interior wells, and this measured radius of influence can then be used to site wells. A good practice is to place wells along the perimeter of the landfill (but still in the refuse) no more than the perimeter radius of influence from the perimeter, and no more than two times the perimeter radius of influence apart. As shown in Figure 5-5, a helpful technique is to site the location of each well and draw a circle with radius equal to the radius of influence (perimeter radius of influence for perimeter wells and interior radius of influence for interior wells). Once the perimeter wells are sited on the landfill plot plan, the interior wells are sited at no more than two times the interior radius of influence in an orientation such that essentially all areas of the landfill are covered by the radii of influence.

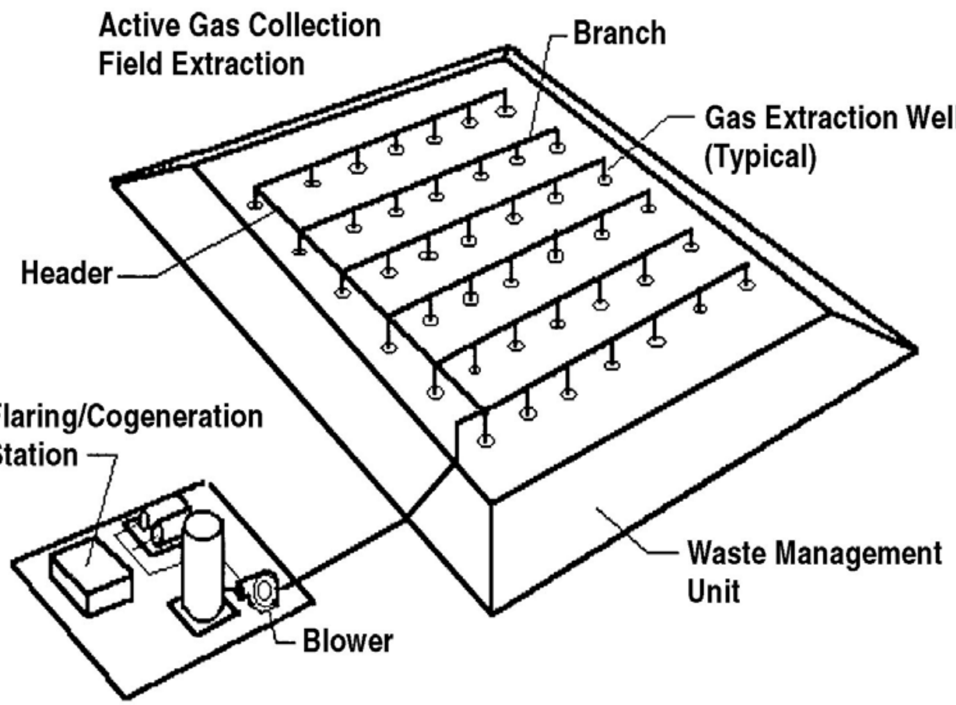


Figure 5-5. Typical Gas Control System.

In situations where field testing is not performed, the well spacing can be determined based on theoretical concepts. Understanding the behavior of LFG through the municipal landfill refuse and cover material is important in order to design the LFG collection system properly. The flow of LFG can be described by Darcy's Law, which correlates the flow of gas through porous media as a function of the gas properties (e.g., density and viscosity), the properties of the porous media (e.g., permeability of refuse and cover), and pressure gradient.

When active collection systems (both vertical and horizontal) are designed, it is also important to understand the relationship between the magnitude of vacuum applied and the degree of air infiltration into the landfill. Excessive air infiltration can kill the methanogens, which produce LFG from the municipal refuse. If excessive air infiltration continues, decomposition becomes aerobic and the internal landfill temperature can increase and possibly lead to a landfill fire. If the landfill conditions are such that air infiltration is significant (e.g., highly permeable cover and/or shallow landfill), the magnitude of vacuum applied may need to be reduced to minimize the amount of air infiltration. A direct consequence of the reduced vacuum is an increased number of wells or trenches required to achieve the same collection efficiency. Therefore, consideration of air infiltration is required in designing the active collection systems for shallow landfills. The problem of air infiltration does not exist for passive systems since passive systems rely on the natural pressure gradient (i.e., difference between atmospheric pressure and internal landfill pressure) rather than applying vacuum.

Appendix G of U.S. EPA (1991) contains detailed information useful in designing active or passive gas collection systems. U.S. EPA (1999b) provides an overview of the design plan requirements for landfills subject to the NSPS or EG. All of the EPA documents concerning MSW landfill regulatory requirements and design criteria are available for download from the EPA website at http://www.epa.gov/ttn/atw/landfill/landflpg.html (accessed August 2005).

5.1.4 LFG to Energy Considerations

Although it may not be required by rule or by hazard and risk assessment, decision makers may want to consider the technical and economic feasibility of using the LFG as an energy source. Using LFG as an energy source helps to reduce odors and other hazards associated with LFG emissions, and it helps prevent methane from migrating into the atmosphere and contributing to local smog and global climate change. MSW landfills are one of the largest sources of human-related CH_4 emissions. At the same time, CH_4 emissions from landfills may represent a lost opportunity to capture and use it as a significant energy resource. The LFG to energy projects are economically driven and are sensitive to customer needs, the volume of gas, and the rate at which it is generated. Once the gas is collected, it may be simply burned or flared (wasted); or be used as an alternative fuel supply for vehicles; or be used to generate electricity; or replace fossil fuels in industrial and manufacturing operations such as cement manufacturing, steel making, and greenhouse operations; or be upgraded to pipeline quality gas. The EPA's Landfill Methane Outreach Program (LMOP) is a voluntary assistance and partnership program that promotes the use of landfill gas as a renewable, green energy source. LMOP helps businesses, States, energy providers, and communities protect the environment and build a sustainable future by preventing emissions of methane through the development of landfill gas energy projects. The Web page for this program is http://www.epa.gov/lmop/ (accessed August 2005).

5.2 Evaluating Existing Gas Collection Systems

In some cases, an active or passive gas collection system will already be in-place at a facility at the time of site discovery. For these types of situations, the existing system should be analyzed to determine if it is adequate for the purposes of collecting the majority of landfill gas and whether an active system is operated in such a way as to minimize the infiltration of ambient air and thus reduce the possibility of landfill fires. The following sections present theoretical procedures that can be used to make a screening-level determination of the adequacy of existing collection systems.

5.2.1 Assessment of Existing Active Gas Collection Systems

To determine if the operating practices for an existing active gas collection system are adequate for reducing air infiltration at the well head, the actual measured vacuum at each well can be compared with a theoretical maximum value that minimizes air infiltration. The following equations from Appendix G of U.S. EPA (1991) can be used to calculate the theoretical maximum vacuum pressure at each well. The theoretical vacuum pressure is then compared with the measured vacuum pressure. If the actual vacuum pressure for a specific well is greater than the theoretical value, consideration should be given to reducing the actual draft at affected wells by re-balancing the active collection system. The theoretical maximum vacuum pressure that minimizes air infiltration (P_v) is calculated by

$$P_v = P_{atm} - \left[(0.25L)(k_{cover}) + (k_{refuse})(D_{cover})\right]\left(\frac{Q_{gen}}{A}\right)\left(\frac{0.0244}{k_{cover}}\right)\left(\frac{\mu_{air}}{k_{refuse}}\right) \qquad 5\text{-}1$$

where:

P_v	=	Theoretical vacuum pressure in Newtons per square meter or pascals,
P_{atm}	=	Atmospheric pressure (101,325 N/m^2),
0.25	=	Assumes well depth is 75% of landfill depth,
L	=	Landfill depth in meters,
k_{cover}	=	Intrinsic cover permeability in square meters,
k_{refuse}	=	Intrinsic refuse permeability in square meters,
D_{cover}	=	Cover thickness in meters,
Q_{gen}	=	Peak landfill gas generation rate in cubic meters per second,
A	=	Landfill area in square meters,
0.0244	=	Fraction of air in landfill gas assuming an allowable O_2 of 0.5%, and
μ_{air}	=	Viscosity of air in Newton-seconds per square meter.

The value of P_v can be converted to units of inches water gauge (w. g.) at 60 °F by dividing P_v by 248.84. The value of the peak landfill gas generation rate (Q_{gen}) is normally determined using the LandGEM model (see Chapter 2). A typical value for the intrinsic refuse permeability (k_{refuse}) is 3.7×10^{-3} m^2; and the viscosity of air (μ_{air}) is 1.8×10^{-5} N-s/m^2. Table 5-1 provides typical values for the permeability (k_{cover}) and thickness (D_{cover}) of three cover materials from U.S. EPA (1991).

Table 5-1. Typical Cover Permeability and Thicknesses.

Cover type	Permeability (m^2)	Thickness (m)
Synthetic	1.0×10^{-18}	7.6×10^{-4}
Clay	5.0×10^{-15}	0.61
Soil	1.0×10^{-14}	0.61

The area of the landfill (A) in Equation 5-1 can be estimated from the design capacity by

$$A = \frac{DC}{\rho^i_{refuse}\, L} \qquad 5\text{-}2$$

where:

A	=	Area of landfill in square meters,
DC	=	Landfill design capacity in kilograms,
ρ^i_{refuse}	=	In situ refuse bulk density in kilograms per cubic meters,

L = Landfill depth in meters.

Once the theoretical vacuum pressure is calculated using Equation 5-1 for each well, the radius of influence (R_a) of the well can be estimated from U.S. EPA (1991) by

$$\frac{P_l^2 - P_v^2}{P_v^2} = \frac{R_a^2 \ln\left(R_a / r\right) \mu_{lfg}\, \rho_{refuse}\, Q_{gen}}{DC\, k_{refuse} \left(WD / L\right)} \qquad 5\text{-}3$$

where:

P_I = Internal landfill pressure in Newtons per square meter,
P_v = Well head vacuum pressure in Newtons per square meter,
R_a = Radius of influence of well in meters,
r = Radius of outer well (casing) in meters,
μ_{lfg} = Landfill gas viscosity in Newton-seconds per square meter,
ρ_{refuse} = Refuse density in kilograms per cubic meters,
Q_{gen} = Peak landfill gas generation rate in cubic meters per second,
DC = Landfill design capacity in kilograms,
k_{refuse} = Intrinsic refuse permeability in square meters,
WD = Well depth in meters,
L = Landfill depth in meters.

The internal landfill pressure (P_I) should be measured at or near the well of interest. The value of the well vacuum pressure (P_v) is calculated by Equation 5-1. The landfill gas viscosity (μ_{lfg}) is 1.15×10^{-5} N-s/m^2, and a typical value for the refuse density (ρ_{refuse}) is 625 kg/m^3.

Equation 5-3 can be solved interactively for the radius of influence (R_a) using an optimization algorithm such as Goal Seek found in the Microsoft Excel spreadsheet program. This is done by entering the equations for the left and right sides of Equation 5-1 within separate cells of the spreadsheet. The Goal Seek algorithm is then invoked such that the value of R_a is changed until both sides of Equation 5-1 are equal.

With a value of the radius of influence for each well, a circle representing the zone of influence of each well can be drawn to scale on a site plot plan. With these data, dead areas between zones of influence can be detected. Dead areas are treated by installing new collection wells. This may be especially important for landfills without side and bottom liners where the surrounding native soils offer relatively low resistance to pressure-driven subsurface vapor flow.

The same type of analysis as that performed above can also be done for horizontal active collection systems as well as for passive collection systems. The reader is referred to Appendix G of U.S. EPA (1991) for the appropriate equations.

The screening-level procedures detailed above are designed to provide a rough estimate of the maximum well head vacuum pressure that minimizes air infiltration and the adequacy of the existing system with regards to LFG collection. It should be noted that the value of the well vacuum pressure calculated using Equation 5-1 assumes that the depth of the well pipe is 75 percent of the depth of the landfill. This assumption is based on a depth at which any possible damage to a landfill bottom liner (if applicable) is avoided. In addition, Equation 5-1 operates under the assumption that 0.5 percent O_2 in the LFG, based on an air concentration of 2.44 percent, is the optimal value. A higher O_2 content may be acceptable (i.e., greater air infiltration) if aerobic decomposition in the upper reaches of the landfill is kept to a minimum and the increased infiltration does not dilute the CH_4 concentration below the UEL of 15 percent by volume. Excessive aerobic conditions are usually detected by an increase in the gas temperature at the well head. Gas temperatures greater than approximately 130 °F indicate that composting is occurring, which increases the possibility of landfill fires.

5.3 Landfill Gas Control Systems

There are two types of LFG control options for SFLs. The first involves destruction of the LFG constituents by combustion, and the second involves energy recovery from the combustion of the gas for the purposes of generating electricity for resale. Energy recovery techniques are used at active MSW landfills and include the use of ICEs, gas turbines, or boiler-to-steam turbine systems. Because SFLs are closed landfills in most cases, information on energy recovery systems is not included in this document.

5.3.1 Open Flares

LFG combustion devices that destroy the gas include open flares and enclosed flares. Open flares can be located at ground level or can be elevated. Although some of these flares operate without external assist (to prevent smoking), most are air-assisted or use the velocity of the gas itself to mix the gas and combustion air. Flares shall be designed for and operated with no visible emissions except for periods not to exceed a total of 5 minutes during any 2 consecutive hours. Flares shall be operated with a flame present at all times and an owner/operator has the choice of adhering to either: (A) meet the heat content specifications (greater than 300 Btu/scf if steam assisted, greater than 200 Btu/scf if unassisted) and meet the maximum tip velocity specifications (less than 60 ft/sec or up to 400 ft/sec if the LFG heat content is greater than 1,000 Btu/scf) or (B) the flare must have a diameter of 3 inches or greater, be operated without assistance, the LFG must have a hydrogen content of 8.0 percent (by volume) or greater, and the flare must not have an exit velocity less than 37.2 m/sec (122 ft/sec). 40 CFR Part 60.18 provides the control device requirements specific to the NSPS applicable to landfill owners using open flares to meet the regulatory requirements.

LFG is conveyed to the open flare through the collection header and transfer lines by one or more blowers. A knock-out drum is normally used to remove gas condensate. The LFG is usually passed through a water seal before going to the flare. This prevents possible flame flashbacks, caused when the gas flow rate to the flare is too low and the flame front pulls down into the stack. Purge gas (N_2, CO_2, or natural gas) also helps to prevent flashback in the flare stack caused by low gas flow rates. The total volumetric flow rate to the flame must be carefully controlled to prevent low flow flashback problems and to avoid flame instability. Figure 5-6 shows a small skid-mounted open flare next to a blower station.

Figure 5-6. Skid-Mounted Open Flare and Blower Station.

5.3.2 Enclosed Flares

Enclosed flares are located at ground level and are enclosed with fire resistant walls (shell) which extend above the top of the flame. Air is admitted in a controlled manner at the bottom of the shell. The temperature above the flame can be monitored and the offgas sampled. This type of flare is in general use at many SFLs because the inlet and combustion gases can be sampled for a determination of the percent NMOC reduction achieved. Figure 5-7 shows an enclosed ground flare and blower station, while Figure 5-8 shows a skid-mounted enclosed ground flare.

Figure 5-7. Enclosed Ground Flare and Blower Station.

Figure 5-8. Small Skid-Mounted Enclosed Ground Flare.

LFG is conveyed to the flare station through the collection header and transfer lines by one or more blowers. Purge gas is usually needed only for initial purging of the system upon start-up or during a restart after a flameout. LFG condensate is removed by a knockout drum. In some cases, LFG condensate is burned in the flare as a liquid stream injected above the burners (see Section 4.2). A water seal or flame barrier is located between the knockout drum and the flare to prevent flashbacks. The number of burner heads and their arrangement into groups for staged operation depends on the LFG flow rate and composition.

To ensure reliable ignition, pilot burners with igniter are provided. The burner heads are enclosed in an internally insulated shell that can be of several shapes, such as cylindrical, hexagonal, or rectangular. The height of the flare must be adequate for creating enough draft to supply sufficient air for smokeless combustion and for dispersion of the thermal plume. Some enclosed flares are equipped with automatic damper controls. The damper controls adjust the intake of air by opening and closing the damper near the base of the stack depending on the combustion temperature. A thermocouple located about 3 feet below the stack outlet is typically used to monitor combustion temperature. Stable combustion and efficient operation can be obtained with landfill gases that have heat contents as low as 100 to 120 Btu/scf. It should be noted that the NSPS standards prohibit the use of flares if the heat content is below 200 Btu/scf; hence supplemental fuel must be provided for flares subject to these regulations.

5.4 Carbon Adsorption Systems

Activated carbon systems are sometimes used to control NMOC emissions from ancillary treatment systems such as leachate air strippers. Activated carbon acts to adsorb the NMOC constituents on the surface area of the carbon granules; for the most part, methane passes through the carbon bed and is not adsorbed. Carbon is activated by a process that greatly increases the surface area of the granules, thus increasing the number of adsorption sites.

Two problems exist with the use of activated carbon. First, water vapor acts as an interferent to adsorption by competing for adsorption sites. Second, the adsorption of certain organic species on activated carbon is minimal. Compounds with one or more of the following physical/chemical properties do not readily adsorb or remain adsorbed to activated carbon, especially at low vapor concentrations and high relative humidities:

- Molecular weight less than 50 g/gmol (approximate),
- Boiling point less than 20 °C,
- Index of refraction at 20 °C less than 1.40.

In addition, other compounds in the gas stream with a higher affinity for carbon adsorption will often dislodge (desorb) these compounds. These factors in combination may result in these types of compounds passing through the carbon bed quickly and, consequently, in unacceptable inhalation risks.

The following equation developed by the activated carbon manufacturer Calgon Corporation, and presented by Yaws et al. (1995), can be used to estimate the activated carbon adsorption capacity of individual organic species:

$$\log_{10} Q_i = A + B\mu_i + C\mu_i^2 + D\mu_i^3 + E\mu_i^4 + F\mu_i^5 \qquad 5\text{-}4$$

where:

Q_i = Adsorption capacity of compound i at equilibrium in cubic centimeters of liquid per 100 g of carbon,
μ_i = Adsorption potential of i (unitless),
A = 1.71
B = -1.46×10^{-2}
C = -1.65×10^{-3}
D = -4.11×10^{-4}
E = 3.14×10^{-5}
F = -6.75×10^{-7}

and

$$\mu_i = \frac{T}{(V_i\,\Gamma_i)\log_{10}\left(P_i^{sat}/p_i\right)} \qquad 5\text{-}5$$

where:

μ_i = Adsorption potential of compound i (unitless),
T = Temperature in Kelvins,
V_i = Liquid molar volume of i in cubic meters per gram-mol, (= 1/density × molecular weight),
Γ_i = Relative polarizability of compound i (unitless),
P_i^{sat} = Vapor pressure of compound i in atmospheres,
p_i = Partial pressure of compound i in atmospheres,

and,

$$\Gamma_i = \frac{\left[\left(n^2 - 1\right)\left(n^2 + 1\right)\right]_i}{\left[\left(n^2 - 1\right)\left(n^2 + 1\right)\right]_{n-heptane}} \quad 5\text{-}6$$

where:

Γ_i = Relative polarizability of compound *i* (unitless), and
n = Index of refraction (unitless).

The index of refraction of the compound of interest can be found in the literature. The following sources list refractive indexes for a wide variety of substances:

- The CRC Handbook of Chemistry and Physics,
- Lange's Handbook of Chemistry,
- The Merck Index,
- Chemical catalogs (e.g., the one from Aldrich Chemical Co.), and
- MSDS datasheets (many are available on the web).

The index of refraction of n-heptane is 1.3876.

The partial pressure of a given constituent (p_i) in Equation 5-5 can be determined from its vapor concentration and the ideal gas law by

$$p_i = \frac{C_{v,i} \times R \times T}{MW_i} \quad 5\text{-}7$$

where:

$C_{v,i}$ = Vapor concentration of compound *i* in grams per cubic centimeter,
R = Ideal gas constant (82.05 atm-cm^3/mol-K),
T = Temperature in Kelvins, and
MW_i = Molecular weight of compound *i* in grams per mol.

An example of using the above procedures is the determination of the adsorption capacity of vinyl chloride on activated carbon at a temperature of 25 °C and an inlet concentration of 100 ppmv. Under these conditions, the adsorption capacity is calculated to be approximately 2.3 grams of vinyl chloride liquid adsorbed for every 100 grams of carbon. As can be seen, the carbon adsorption capacity of vinyl chloride is very small. For this reason, a subsequent risk evaluation would be done assuming that the vinyl chloride emissions are essentially uncontrolled.

In addition to the procedures cited above for estimating the adsorption capacity, adsorption isotherms relating the adsorption capacity as a function of the partial pressure and temperature can often be acquired from the manufacturer of the activated carbon. These isotherms and the equations given above assume a single contaminant in the vapor stream. Actual adsorption of individual contaminants in a multi-component vapor stream will be somewhat less.

5.5 Stack Sampling

Methods for assessing combustion equipment emissions (e.g., enclosed flares, boilers, ICEs, etc.) are given in Table 5-2. These include methods for such pollutants as NO_X, SO_2, CO, and NMOCs and for toxic LFG COPCs. Table 5-2 contains a column for EPA Reference Test Methods found in 40 CFR Part 60, Appendix A and a column for RCRA SW-846 Test Methods. SW-846 is a compendium of RCRA test methods titled *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods* and is available from the EPA Office of Solid Waste website at: *http://www.epa.gov/sw-846/* (accessed August 2005).

Table 5-2. Stack Sampling Methods for LFG Combustion Equipment.

Pollutant	EPA Reference Methods	EPA SW-846 Methods
Oxides of nitrogen (NO_X)	7 or 7E	NA[a]
Sulfur dioxide (SO_2)	6	NA
Carbon monoxide (CO)	10 or 3C	NA
Nonmethane organic compounds (NMOCs)	25/25A/25B or 18	NA
Volatile organic compounds (VOCs)	18	0030 or 0031
Chlorinated dioxins/furans	23	0023A
Hydrogen chloride (HCl)	26	0050 or 0051
Mercury (Hg)	101A	0060

[a] NA = Not applicable.

In some respects, the SW-846 test methods may be more suitable for high temperature combustion sources such as enclosed flares. EPA Reference Methods 25 or 18, however, must be used to determine compliance with the 98 percent by weight NMOC reduction requirements or the 20 ppmv NMOC concentration requirements of the NSPS or EG.

Mercury-bearing material has been placed in municipal landfills from a wide array of sources including fluorescent lights, batteries, electrical switches, thermometers, and general waste. Despite its known volatility, persistence, and toxicity in the environment, the fate of mercury (Hg) in landfills has not been widely studied. Landfills are designed to reduce waste through generation of methane by anaerobic bacteria. This suggests the possibility that these degradation systems might also serve as bioreactors capable of generating methylated Hg compounds. The toxicity of these Hg compounds indicates the need to determine if they are emitted in municipal landfill gas (LFG).

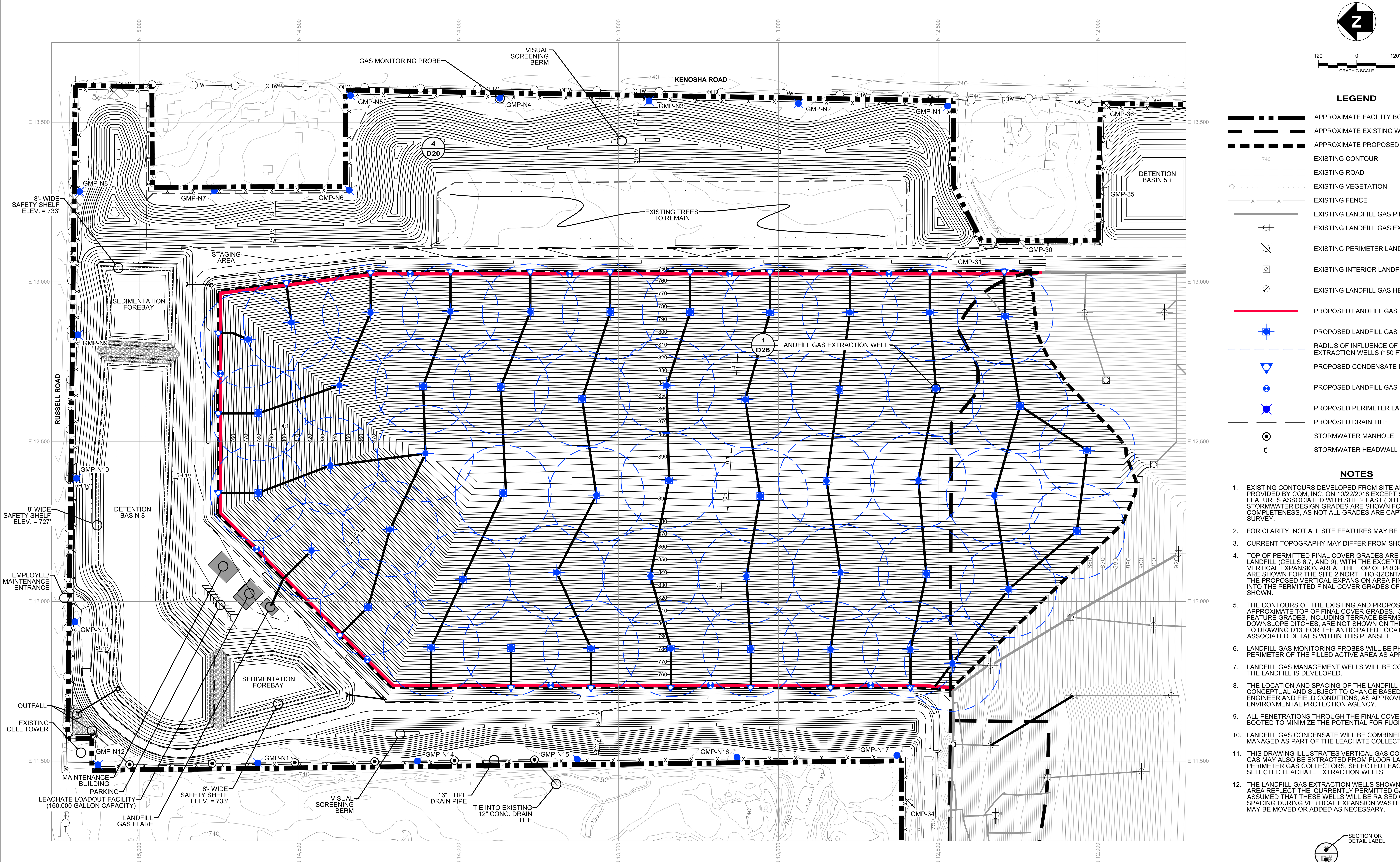
Mercury is a highly toxic heavy metal that exists primarily in three forms: elemental Hg, inorganic Hg compounds (e.g., mercuric chloride), and organic Hg compounds (e.g., methyl and dimethyl mercury). People are most likely to be exposed to Hg through the consumption of fish or seafood. Mercury is most likely to be present in fish tissue as methyl mercury, which happens to be the most toxic form of Hg to humans. However, concern over air emissions is not limited to methyl mercury because other forms of Hg can be converted to methyl mercury in the environment through methylation.

In the initial development of emissions factors for constituents of LFG, the U.S. EPA published a default total Hg concentration in AP-42 equivalent to 292 parts per trillion (ppt), with no data on individual Hg species. At this concentration, Hg emissions from landfills are extremely low, if not negligible. However, in the late 1990s, a study conducted by Lindberg et al. at a landfill in Florida suggested that levels of total Hg in LFG might be several times higher than EPA default values, though still much lower than other common landfill trace constituents. This study was also perhaps the first to positively identify the more toxic organic mercury compounds methyl and dimethyl mercury in LFG.

EPA researchers measured Hg inside the landfill gas vents at concentrations ranging from a few hundred to several thousand nanograms per cubis meter. Although the higher end is equivalent to levels emitted by a coal-fired utility plant, the volume of gas emitted at a landfill is considerably lower. Consequently, the overall contribution of Hg to the atmosphere from municipal landfill gas is small in comparison to coal-fired power plants. However, there may be important contributions of Hg to the atmosphere in the immediate local area near the landfill.

During the NESHAP rule making, EPA found insufficient data to adequately characterize the concentrations of Hg in landfill gas or determine their significance. Based on the available information, it was concluded that the Maximum Achievable Control Technology (MACT) floor for Hg is no emissions reductions because there are no alternatives above that floor. The NESHAP standard does not require a reduction in Hg emissions. Although the NESHAP does not require Hg emissions reductions, the risks and hazards associated with mercury continues to be a sensitive subject with the ecological community.

ATTACHMENT 4
Revised Drawing No. D14 Showing Radii of Influence



LEGEND

- APPROXIMATE FACILITY BOUNDARY
- APPROXIMATE EXISTING WASTE BOUNDARY
- APPROXIMATE PROPOSED EXPANSION WASTE BOUNDARY
- EXISTING CONTOUR
- EXISTING ROAD
- EXISTING VEGETATION
- EXISTING FENCE
- EXISTING LANDFILL GAS PIPE
- EXISTING LANDFILL GAS EXTRACTION WELL
- EXISTING PERIMETER LANDFILL GAS PROBE
- EXISTING INTERIOR LANDFILL GAS MONITORING DEVICE
- EXISTING LANDFILL GAS HEADER CONTROL VALVE
- PROPOSED LANDFILL GAS HEADER
- PROPOSED LANDFILL GAS EXTRACTION WELL
- RADIUS OF INFLUENCE OF GAS PROPOSED GAS EXTRACTION WELLS (150 FT)
- PROPOSED CONDENSATE DRIP LEG
- PROPOSED LANDFILL GAS HEADER CONTROL VALVE
- PROPOSED PERIMETER LANDFILL GAS PROBE
- PROPOSED DRAIN TILE
- STORMWATER MANHOLE
- STORMWATER HEADWALL

NOTES

1. EXISTING CONTOURS DEVELOPED FROM SITE AERIAL TOPOGRAPHIC SURVEY PROVIDED BY CQM, INC. ON 10/22/2018 EXCEPT STORMWATER MANAGEMENT FEATURES ASSOCIATED WITH SITE 2 EAST (DITCHES AND BASIN 5R). STORMWATER DESIGN GRADES ARE SHOWN FOR THESE FEATURES, FOR COMPLETENESS, AS NOT ALL GRADES ARE CAPTURED BY THE TOPOGRAPHIC SURVEY.
2. FOR CLARITY, NOT ALL SITE FEATURES MAY BE SHOWN.
3. CURRENT TOPOGRAPHY MAY DIFFER FROM SHOWN.
4. TOP OF PERMITTED FINAL COVER GRADES ARE SHOWN FOR THE EXISTING LANDFILL (CELLS 6,7, AND 9), WITH THE EXCEPTION OF THE SITE 2 NORTH VERTICAL EXPANSION AREA. THE TOP OF PROPOSED FINAL COVER GRADES ARE SHOWN FOR THE SITE 2 NORTH HORIZONTAL AND VERTICAL EXPANSION. THE PROPOSED VERTICAL EXPANSION AREA FINAL COVER GRADES WILL TIE INTO THE PERMITTED FINAL COVER GRADES OF THE EXISTING LANDFILL AS SHOWN.
5. THE CONTOURS OF THE EXISTING AND PROPOSED LANDFILL REPRESENT THE APPROXIMATE TOP OF FINAL COVER GRADES. STORMWATER CONTROL FEATURE GRADES, INCLUDING TERRACE BERMS, LETDOWN PIPES, AND DOWNSLOPE DITCHES, ARE NOT SHOWN ON THIS DRAWING. PLEASE REFER TO DRAWING D13 FOR THE ANTICIPATED LOCATION OF THESE FEATURES AND ASSOCIATED DETAILS WITHIN THIS PLANSET.
6. LANDFILL GAS MONITORING PROBES WILL BE PHASED IN AROUND THE PERIMETER OF THE FILLED ACTIVE AREA AS APPROVED BY THE IEPA.
7. LANDFILL GAS MANAGEMENT WELLS WILL BE CONSTRUCTED IN PHASES AS THE LANDFILL IS DEVELOPED.
8. THE LOCATION AND SPACING OF THE LANDFILL GAS EXTRACTION SYSTEM IS CONCEPTUAL AND SUBJECT TO CHANGE BASED ON THE DISCRETION OF THE ENGINEER AND FIELD CONDITIONS, AS APPROVED BY THE ILLINOIS ENVIRONMENTAL PROTECTION AGENCY.
9. ALL PENETRATIONS THROUGH THE FINAL COVER GEOMEMBRANE WILL BE BOOTED TO MINIMIZE THE POTENTIAL FOR FUGITIVE EMISSIONS.
10. LANDFILL GAS CONDENSATE WILL BE COMBINED WITH LEACHATE AND MANAGED AS PART OF THE LEACHATE COLLECTION SYSTEM.
11. THIS DRAWING ILLUSTRATES VERTICAL GAS COLLECTION WELLS. LANDFILL GAS MAY ALSO BE EXTRACTED FROM FLOOR LATERAL GAS COLLECTORS, PERIMETER GAS COLLECTORS, SELECTED LEACHATE CLEANOUT RISERS, AND SELECTED LEACHATE EXTRACTION WELLS.
12. THE LANDFILL GAS EXTRACTION WELLS SHOWN IN THE VERTICAL EXPANSION AREA REFLECT THE CURRENTLY PERMITTED GAS EXTRACTION SYSTEM. IT IS ASSUMED THAT THESE WELLS WILL BE RAISED OR REPLACED AT A SIMILAR SPACING DURING VERTICAL EXPANSION WASTE PLACEMENT AND HEADERS MAY BE MOVED OR ADDED AS NECESSARY.

SECTION OR DETAIL LABEL

DRAWING ON WHICH SECTION OR DETAIL IS SHOWN

SECTIONS AND DETAIL KEY

REV. NO.	DATE	DESCRIPTION

GFL GREEN FOR LIFE environmental

APTIM Environmental & Infrastructure, LLC

ZION LANDFILL - SITE 2 NORTH EXPANSION
CITY OF ZION, ILLINOIS

CONCEPTUAL LANDFILL GAS MANAGEMENT SYSTEM SHOWING RADII OF INFLUENCE

PROJ. NO.: 631020105	DATE: FEBRUARY 2023	
DESIGNED BY: DAM/BWM	DRAWING NO.	
DRAWN BY: BWM/NV/KM	D14	
CHECKED BY: DAM		
APPROVED BY: DAM	14 OF 37 SHEETS	

ATTACHMENT 5
Illinois DOT Standard Specifications for Road and Bridge Construction
Section 250 - Seeding

APTIM

Standard Specifications for Road and Bridge Construction

Adopted January 1, 2022

Illinois Department of Transportation

Other means of locating existing farm underdrains approved by the Engineer will be paid for according to Article 109.04.

SECTION 214. GRADING AND SHAPING DITCHES

214.01 Description. This work shall consist of grading and shaping existing ditches according to the lines, grades, and cross sections shown on the plans.

CONSTRUCTION REQUIREMENTS

214.02 General. All surplus and unsuitable material shall be disposed of according to Article 202.03.

214.03 Method of Measurement. This work will be measured for payment in feet (meters) along the centerline of the ditch.

The volume of any surplus or unsuitable material removed will be measured for payment according to Article 202.07.

214.04 Basis of Payment. This work will be paid for at the contract unit price per foot (meter) for GRADING AND SHAPING DITCHES.

Earth excavation for surplus material and removal and disposal of unsuitable material will be paid for according to Article 202.08.

LANDSCAPING

SECTION 250. SEEDING

250.01 Description. This work shall consist of preparing the seed bed and placing the seed and other materials required in seeding operations on the shoulders, slopes, and other areas.

250.02 Materials. Materials shall be according to the following.

Item	Article/Section
(a) Seeds	1081.04
(b) Agricultural Ground Limestone	1081.07
(c) Fertilizer	1081.08

250.03 Equipment. Equipment shall be according to the following.

Item	Article/Section
(a) Disk	1101.08(a)
(b) Slope Harrow	1101.08(b)
(c) Hydraulic Seeder	1101.08(c)
(d) Cultipacker	1101.08(d)

CONSTRUCTION REQUIREMENTS

250.04 Fertilizer and Agricultural Ground Limestone Application. When specified for bare earth areas, fertilizer nutrients and agricultural ground limestone shall be uniformly spread over the designated areas immediately prior to seed bed preparation.

When specified for existing turf areas, fertilizer nutrients and agricultural ground limestone shall be uniformly spread over the designated areas during the spring, late summer, or early fall seasons. The Contractor shall restore any existing turf areas damaged by improper application of fertilizer nutrients or agricultural ground limestone.

When fertilizer is specified, 270 lb (300 kg) of fertilizer nutrients per acre (hectare) shall be applied at 1:1:1 ratio as follows.

Nitrogen Fertilizer Nutrients	90 lb/acre (100 kg/ha)
Phosphorus Fertilizer Nutrients	90 lb/acre (100 kg/ha)
Potassium Fertilizer Nutrients	90 lb/acre (100 kg/ha)

When agricultural ground limestone is specified, it shall be applied at a rate of 2 tons/acre (4.5 metric tons/ha) multiplied by the source correction factor.

250.05 Seed Bed Preparation. For bare earth seeding, seed bed preparation shall not be started until all requirements of Section 212 have been completed. The area to be seeded shall be worked to a minimum depth of 3 in. (75 mm) with a disk, tiller, or other equipment approved by the Engineer, reducing all soil particles to a size not larger than 2 in. (50 mm) in the largest dimension. The prepared surface shall be relatively free from weeds, clods, stones, roots, sticks, rivulets, gullies, crusting, and caking. If the area is to be covered by an erosion control blanket or turf reinforcement mat, the seed bed shall comply with the preparation requirements of Article 251.04 for erosion control blanket or Article 251.05 for turf reinforcement mat prior to application of seed. No seeds shall be sown until the seed bed has been approved by the Engineer.

Seed bed preparation will not be required for Class 7 Seeding if the soil is in a loose condition. Light disking shall be done if the soil is hard or caked.

For areas in which a stand of winter wheat exists, as a result of temporary erosion control seeding, disking will be required.

250.06 Seeding Methods. No seed shall be sown during high winds or when the ground is not in a proper condition for seeding, nor shall any seed be sown until the purity test has been completed for the seeds to be used, and shows that the seed meets the noxious weed seed requirements. All equipment shall be approved by the Engineer prior to being used. Prior to starting work, seeders and interseeders shall be calibrated and adjusted to sow seeds at the required seeding rate. Equipment shall be operated in a manner to ensure complete coverage of the entire area to be seeded or interseeded. The Engineer shall be notified 48 hours prior to beginning the seeding operations so that the Engineer may determine by trial runs that a calibration of the seeder will provide uniform distribution at the specified rate per acre (hectare). When seed or fertilizer is applied with a hydraulic seeder, the rate of application shall be not less than 1000 gal (9500 L) of slurry per acre (hectare). This slurry shall contain the proper quantity of seed or fertilizer nutrients specified per acre (hectare). When using a hydraulic seeder, the fertilizer nutrients and seed shall be applied in two separate operations.

All legumes (clover and alfalfa) shall be inoculated with the proper bacteria in the amounts and manner recommended by the manufacturer of the inoculant before sowing or being mixed with other seeds for sowing. The inoculant shall be furnished by the Contractor and shall be approved by the Engineer. The seed shall be sown as soon as possible after inoculation. Seed that has been standing more than 24 hours after inoculation shall be reinoculated before sowing. If legumes are applied by a hydraulic seeder, three times the normal amount of inoculant shall be used.

(a) Bare Earth Seeding. Bare earth seeding shall be done using the following methods unless otherwise specified or directed by the Engineer.

(1) Seeding Classes 1, 2, and 6 shall be sown with a machine that mechanically places the seed in direct contact with the soil, packs, and covers the seed in one continuous operation.

(2) Seeding Class 4 shall be sown with a rangeland type grass drill.

(3) Seeding Class 3 may be sown with a hydraulic seeder.

(4) Seeding Classes 5 and 7 shall be sown with a hydraulic seeder or rangeland type grass drill.

Broadcasting or hydraulic seeding will be allowed as approved by the Engineer on steep slopes (over 1:3 (V:H)) or in inaccessible areas where use of the equipment specified is physically impossible. When broadcast seeders are used for Seeding Class 3 or 4, the individual seeds comprising the seeding mixture shall be sown separately. When Seeding Class 7 is used as an erosion control measure to establish temporary cover, hand broadcasting of the seed or other methods approved by the Engineer will be allowed.

(b) Interseeding. Interseeding is the seeding of areas of existing turf. Prior to interseeding, all areas of existing turf to be interseeded, except as listed below, shall be mowed one or more times to a height of not more than 3 in. (75 mm). The equipment used shall be capable of completely severing all growth at the cutting height and distributing it evenly over the mowed area. The cut material shall not be windrowed or left in a lumpy or bunched condition. Additional mowing may be required, as directed by the Engineer, on certain areas in order to disperse the mowed material and allow penetration of the seed. The Contractor will not be required to mow within 1 ft (300 mm) of the right-of-way fence, continuously wet ditches and drainage ways, slopes 1:3 (V:H) and greater, or areas which may be designated as not mowable by the Engineer.

Debris encountered during the mowing and interseeding operations which hamper the operation or are visible from the roadway shall be removed and disposed of according to Article 250.05. Damage to the right-of-way and turf, such as ruts or wheel tracks more than 2 in. (50 mm) in depth, shall be repaired to the satisfaction of the Engineer prior to the time of interseeding.

All seeding classes shall be interseeded using a rangeland type grass drill with an interseeding attachment, except the following.

(1) When specified in the plans or directed by the Engineer, a slit seeder shall be used to interseed Class 1 or Class 2 seed.

(2) Broadcasting or hydraulic seeding will be allowed as approved by the Engineer on steep slopes (1:3 (V:H) or steeper) or in inaccessible areas where use of the equipment specified is physically impossible. Sufficient water shall be applied to these areas to wash the seed down to the soil.

When broadcast seeders are used for Seeding Class 3 or 4, the individual seeds comprising the seeding mixture shall be sown separately.

250.07 Seeding Mixtures. The classes of seeding mixtures and combinations of mixtures will be designated in the plans.

When an area is to be seeded with two or more seeding classes, those mixtures shall be applied separately on the designated area within a seven day period. All seeding shall occur prior to placement of mulch cover. A Class 7 mixture can be applied at any time prior to applying any seeding class or added to them and applied at the same time.

TABLE 1 - SEEDING MIXTURES			
Class - Type		Seeds	lb/acre (kg/hectare)
1	Lawn Mixture 7/	Ky Bluegrass Perennial Ryegrass Creeping Red Fescue	100 (110) 60 (70) 40 (50)
1A	Salt Tolerant Lawn Mixture 7/	Bluegrass Perennial Ryegrass Red Fescue (Audubon, Sea Link, or Epic) Hard Fescue (Rescue 911, Spartan II, or Reliant IV) Fults Salt Grass 1/ or Salty Alkaligrass	60 (70) 20 (20) 20 (20) 20 (20) 60 (70)
1B	Low Maintenance Lawn Mixture 7/	Fine Leaf Turf-Type Fescue 3/ Perennial Ryegrass Red Top Creeping Red Fescue	150 (170) 20 (20) 10 (10) 20 (20)
2	Roadside Mixture 7/	Tall Fescue (Inferno, Tarheel II, Quest, Blade Runner, or Falcon IV) Perennial Ryegrass Creeping Red Fescue Red Top	100 (110) 50 (55) 40 (50) 10 (10)
2A	Salt Tolerant Roadside Mixture 7/	Tall Fescue (Inferno, Tarheel II, Quest, Blade Runner, or Falcon IV) Perennial Ryegrass Red Fescue (Audubon, Sea Link, or Epic) Hard Fescue (Rescue 911, Spartan II, or Reliant IV) Fults Salt Grass 1/ or Salty Alkaligrass	60 (70) 20 (20) 30 (20) 30 (20) 60 (70)
3	Northern Illinois Slope Mixture 7/	Elymus Canadensis (Canada Wild Rye) 5/ Perennial Ryegrass Alsike Clover 2/ Desmanthus Illinoensis (Illinois Bundleflower) 2/, 5/ Andropogon Scoparius (Little Bluestem) 5/ Bouteloua Curtipendula (Side-Oats Grama) 5/ Fults Salt Grass 1/ or Salty Alkaligrass Oats, Spring Slender Wheat Grass 5/ Buffalo Grass (Cody or Bowie) 4/, 5/, 9/	5 (5) 20 (20) 5 (5) 2 (2) 12 (12) 10 (10) 30 (35) 50 (55) 15 (15) 5 (5)
3A	Southern Illinois Slope Mixture 7/	Perennial Ryegrass Elymus Canadensis (Canada Wild Rye) 5/ Panicum Virgatum (Switchgrass) 5/ Andropogon Scoparius (Little Blue Stem) 5/ Bouteloua Curtipendula (Side-Oats Grama) 5/ Petalostemum Candidum (White Prairie Clover) 5/ Rudbeckia Hirta (Black-Eyed Susan) 5/ Oats, Spring	20 (20) 20 (20) 10 (10) 12 (12) 10 (10) 5 (5) 5 (5) 50 (55)

Class - Type		Seeds	lb/acre (kg/hectare)
4	Native Grass 6/, 8/	Andropogon Gerardi (Big Blue Stem) 5/	4 (4)
		Andropogon Scoparius (Little Blue Stem) 5/	5 (5)
		Bouteloua Curtipendula (Side-Oats Grama) 5/	5 (5)
		Elymus Canadensis (Canada Wild Rye) 5/	1 (1)
		Panicum Virgatum (Switch Grass) 5/	1 (1)
		Sorghastrum Nutans (Indian Grass) 5/	2 (2)
		Annual Ryegrass	25 (25)
		Oats, Spring	25 (25)
		Perennial Ryegrass	15 (15)
4A	Low Profile Native Grass 6/, 8/	Andropogon Scoparius (Little Blue Stem) 5/	5 (5)
		Bouteloua Curtipendula (Side-Oats Grama) 5/	5 (5)
		Elymus Canadensis (Canada Wild Rye) 5/	1 (1)
		Sporobolus Heterolepsis (Prairie Dropseed) 5/	0.5 (0.5)
		Annual Ryegrass	25 (25)
		Oats, Spring	25 (25)
		Perennial Ryegrass	15 (15)
4B	Wetland Grass and Sedge Mixture 6, 8/	Annual Ryegrass	25 (25)
		Oats, Spring	25 (25)
		Wetland Grasses (species below)	6 (6)

Species:	% By Weight 5/
Calamagrostis Canadensis (Blue Joint Grass)	12
Carex lacustris (Lake-Bank Sedge)	6
Carex slipata (Awl-Fruited Sedge)	6
Carex stricta (Tussock Sedge)	6
Carex vulpinoidea (Fox Sedge)	6
Eleocharis aciculoris (Needle Spike Rush)	3
Eleocharis obtusa (Blunt Spike Rush)	3
Glyceria striata (Fowl Manna Grass)	14
Juncus effusus (Common Rush)	6
Juncus tenuis (Slender Rush)	6
Juncus torreyi (Torrey's Rush)	6
Leersia oryzoides (Rice Cut Grass)	10
Scirpus acutus (Hard-Stemmed Bulrush)	3
Scirpus atrovirens (Dark Green Rush)	3
Scirpus fluviatilis (River Bulrush)	3
Scirpus validus (Softstem Bulrush)	3
Spartina pectinata (Cord Grass)	4

Class - Type		Seeds	lb/acre (kg/hectare)
5	Forb with Annuals Mixture	Annuals Mixture (Below) 6/, 8/ Forb Mixture (Below) 6/, 8/	1 (1) 10 (10)

Annuals Mixture - Mixture not exceeding 25 % by weight of any one species, of the following:

Coreopsis lanceolata (Sand Coreopsis)
Chrysanthemum maximum (Shasta Daisy)
Gaillardia pulchelle (Blanket Flower)
Ratibida columnitera (Long-Headed Coneflower)
Rudbeckia hirta (Black-Eyed Susan)

Forb Mixture - Mixture not exceeding 5 % by weight PLS of any one species, of the following:

Amorpha canescens (Lead Plant) 2/
Anemone cylindrica (Thimble Weed)
Asclepias tuberosa (Butterfly-Weed)
Aster azureus (Sky Blue Aster)
Aster laevis (Smooth Aster)
Aster novae-angliae (New England Aster)
Baptisia leucantha (White Wild Indigo) 2/
Coreopsis palmata (Prairie Coreopsis)
Echinacea pallida (Pale Purple Coneflower)
Eryngium yuccifolium (Rattlesnake Master)
Helianthus mollis (Downy Sunflower)
Heliopsis helianthoides (Ox-Eye)
Liatris aspera (Rough Blazing Star)
Liatris pyscostachya (Prairie Blazing Star)
Monarda fistulosa (Prairie Bergamont)
Parthenium integrifolium (WildQuinine)
Petalostemum candidum (White Prairie Clover) 2/
Petalostemum purpureum (Purple Prairie Clover) 2/
Physostegia virginiana (False Dragonhead)
Potentilla arguta (Prairie Cinquefoil)
Ratibida pinnata (Yellow Coneflower)
Rudbeckia subtomentosa (Fragrant Coneflower)
Silphium laciniatum (Compass Plant)
Silphium terebinthinaceum (Prairie Dock)
Solidago rigida (Rigid Goldenrod)
Tradescantia ohiensis (Spiderwort)
Veronicastrum virginicum (Culver's Root)

Class - Type		Seeds	lb/acre (kg/hectare)
5A	Large Flower Native Forb Mixture 6/, 8/	Forb Mixture (see below)	5 (5)
		<u>Species:</u>	<u>% By Weight</u> 5/
		Aster novae-angliae (New England Aster)	5
		Echinacea pallida (Pale Purple Coneflower)	10
		Helianthus mollis (Downy Sunflower)	10
		Heliopsis helianthoides (Ox-Eye)	10
		Liatris pyscostachya (Prairie Blazing Star)	10
		Ratibida pinnata (Yellow Coneflower)	5
		Rudbeckia hirta (Black-Eyed Susan)	10
		Silphium laciniatum (Compass Plant)	10
		Silphium terebinthinaceum (Prairie Dock)	20
		Solidago rigida (Rigid Goldenrod)	10
5B	Wetland Forb	Forb Mixture (see below) 6/, 8/	2 (2)
		<u>Species:</u>	<u>% By Weight</u> 5/
		Acorus calamus (Sweet Flag)	3
		Angelica atropurpurea (Angelica)	6
		Ascelepias incarnata (Swamp Milkweed)	2
		Aster puniceus (Purple Stemmed Aster)	10
		Bidens cernua (Beggarticks)	7
		Eupatorium maculatum (Spotted Joe Pye Weed)	7
		Eupatorium perfoliatum (Boneset)	7
		Helenium autumnale (Autumn Sneeze Weed)	2
		Iris virginica shrevei (Blue Flag Iris)	2
		Lobelia cardinalis (Cardinal Flower)	5
		Lobelia siphilitica (Great Blue Lobelia)	5
		Lythrum alatum (Winged Loosestrife)	2
		Physostegia virginiana (False Dragonhead)	5
		Polygonium pensylvanicum (Pennsylvania Smartweed)	10
		Polygonum lapathifolium (Curlytop Knotweed)	10
		Pychanthemum virginianum (Mountain Mint)	5
		Rudbeckia laciniata (Cut-leaf Coneflower)	5
		Solidago riddellii (Riddell Goldenrod)	2
		Sparganium eurycarpum (Giant Burreed)	5
6	Conservation Mixture	Andropogon Scoparius (Little Blue Stem) 5/	5 (5)
		Elymus Canadensis (Canada Wild Rye) 5/	2 (2)
		Buffalo Grass (Cody or Bowie) 4/, 5/, 9/	5 (5)
		Vernal Alfalfa 2/	15 (15)
		Oats, Spring	48 (55)
6A	Salt Tolerant Conservation Mixture	Andropogon Scoparius (Little Blue Stem) 5/	5 (5)
		Elymus Canadensis (Canada Wild Rye) 5/	2 (2)
		Buffalo Grass (Cody or Bowie) 4/, 5/, 9/	5 (5)
		Vernal Alfalfa 2/	15 (15)
		Oats, Spring	48 (55)
		Fults Salt Grass 1/ or Salty Alkaligrass	20 (20)
7	Temporary Turf Cover Mixture	Perennial Ryegrass	50 (55)
		Oats, Spring 4/	64 (70)

Notes:

1/ Fults pucinnellia distans.
2/ Legumes - inoculation required.
3/ Specific variety as shown in the plans or approved by the Engineer.
4/ Other seeds may be used if approved by the Engineer.
5/ PLS = Pure Live Seed to be used.
6/ Fertilizer not required.
7/ In Districts 1 through 6, the planting times shall be April 1 to June 15 and August 1 to November 1. In Districts 7 through 9, the planting times shall be March 1 to June 1 and August 1 to November 15. Seeding may be performed outside these dates provided the Contractor guarantees a minimum of 75 percent uniform growth over the entire seeded area(s) after a period of establishment. Inspection dates for the period of establishment will be as follows: Seeding conducted in Districts 1 through 6 between June 16 and July 31 will be inspected after April 15 and seeding conducted between November 2 and March 31 will be inspected after September 15. Seeding conducted in Districts 7 through 9 between June 2 and July 31 will be inspected after April 15 and seeding conducted between November 16 and February 28 will be inspected after September 15. The guarantee shall be submitted to the Engineer in writing prior to performing the work. After the period of establishment, areas not exhibiting 75 percent uniform growth shall be interseeded or reseeded, as determined by the Engineer, at no additional cost to the Department.
8/ Planting times May 15 to June 30 and October 15 to December 1.
9/ Seed shall be primed with KNO_3 to break dormancy and dyed to indicate such.

Variation in the Class 4 or 5 seed quantities or varieties will be allowed in the event of a crop failure or other unforeseen conditions. The Contractor shall provide for the approval of the Engineer a written description of the changed Class 4 or 5 Mixture, the reasons for the change, and the name of the seed supplier.

250.08 Selective Mowing Stakes. Selective mowing stakes shall be installed to delineate areas to be seeded or interseeded with Class 4 or 5 mixtures. Selective mowing stakes shall be steel posts as described in Article 1081.13(a). The selective mowing stakes shall be driven into the ground to a height of 3 1/2 ft (1.1 m) above the ground at locations shown on the plans and as directed by the Engineer.

250.09 Method of Measurement. This work will be measured for payment as follows.

(a) Contract Quantities. The requirement for use of contract quantities shall be according to Article 202.07(a).

(b) Measured Quantities. Seeding of the class specified and mowing will be measured in acres (hectares) of surface area seeded or mowed.

The exact locations of seeding and mowing will be determined in the field by the Engineer, and the quantities will be adjusted accordingly. Fertilizer will be measured by weight in pounds (kilograms) of actual nutrients. The percent of nutrients equals the guaranteed analysis on the bag. The following formula will be used to determine the pounds (kilograms) of fertilizer nutrients applied.

(Total pounds (kilograms) of mixed fertilizer)
X
(Percentage of each nutrient in the fertilizer applied)
= pounds (kilograms) of each fertilizer nutrient

Agricultural Ground Limestone will be measured by weight in tons (metric tons) of Agricultural Ground Limestone having an effective neutralizing value of 67.5 (four year base, a source correction factor of 1.0). Applied quantity shall be the plan quantity multiplied by the source correction factor. The pay quantity will be the applied quantity divided by the source correction factor.

Payment will not be made for fertilizer nutrients in excess of 103 percent or agricultural ground limestone in excess of 108 percent of the amounts specified by the Engineer.

Selective mowing stakes will be measured as each in place.

250.10 Basis of Payment. This work will be paid for at the contract unit price per acre (hectare) for SEEDING or INTERSEEDING of the Class specified; at the contract unit prices per pound (kilogram) for NITROGEN FERTILIZER NUTRIENT, PHOSPHORUS FERTILIZER NUTRIENT and POTASSIUM FERTILIZER NUTRIENT; and at the contract unit price per ton (metric ton) for AGRICULTURAL GROUND LIMESTONE.

Mowing will be paid for at the contract unit price per acre (hectare) for MOWING. Only the initial mowing will be paid for. Any subsequent mowing required to obtain a height of not more than 3 in. (75 mm) or to disperse mowed material will be considered as included in the cost of the initial mowing.

Selective Mowing Stakes will be paid for at the contract unit price per each for SELECTIVE MOWING STAKES.

ATTACHMENT 6
Revised appendix O – Construction Quality Assurance

TABLE OF CONTENTS

APTIM

1.0 PURPOSE AND SCOPE

1.1 Purpose

The purpose of this Construction Quality Assurance Plan (CQA Plan) is to provide procedures to assure that landfill components of the Zion Landfill are constructed and documented in adherence to their design and regulatory requirements.

This CQA Plan has been prepared in accordance with the requirements of Title 35 Illinois Administrative Code Part 811 Subpart E and Appendix D to IEPA Landfill Permit Application Instructions Form No. LPC-PA2. This CQA Plan is intended to serve as a guide and can be modified upon IEPA approval to reflect current industry standards with regard to laboratory testing methods and requirements.

1.2 Scope

Construction components and facilities subject to this CQA Plan are as follows:

Construction Component	Applicable Sections*
Foundation and Subgrades	2.0 –5.0, 6.0, 8.0
Test Liner	2.0 –5.0, 6.0, 7.0, 8.0
Gradient Control Layer	2.0 –5.0, 14.0, 15.0
Compacted Low-Permeability Soil Liner	2.0 –5.0, 7.0, 8.0
Geomembrane Installation	2.0 –5.0, 11.0
Leachate Drainage and Collection System	2.0 –5.0, 10.0, 12.0, 13.0, 14.0, 15.0
Final Cover System	2.0 –5.0, 7.0, 8.0, 9.0, 11.0, 12.0, 13.0, 14.0, 15.0
Surface Water Control Facilities	2.0 –5.0, 12.0, 15.0, 16.0
Gas Control System	2.0 – 5.0, 17.0
Leachate Storage Tanks	2.0 –5.0, 19.0

* NOTE: Sections 2.0 through 5.0 are applicable to all landfill components.

Sections 2.0 through 5.0 discuss CQA requirements common to all the components of landfill construction. These common requirements include Roles, Responsibilities, and Qualifications (Section 2.0), Preconstruction Planning (Section 3.0), General Inspection and Documentation (Section 4.0), and the Construction Acceptance Report (Section 5.0).

Sections 6.0 through 19.0 discuss specific construction procedures, observation, sampling, testing, acceptance criteria, surveying and documentation requirements for each material utilized in construction of landfill components. Several sections will have to be referenced for landfill components constructed of multiple materials. For example, the final cover utilizes general fill (final protective layer), geocomposite, geomembrane, and low-permeability soil (low-permeability layer).

2.0 OPERATOR AND CQA ROLES, RESPONSIBILITIES, AND QUALIFICATION

2.1 Owner/Operator

For each component of landfill construction addressed by this CQA Plan, the Owner/Operator shall retain professional services of a third party other than the Owner/Operator or an employee of the Operator to fulfill the requirements of the CQA Officer.

2.2 CQA Officer

The CQA Officer shall supervise and be responsible for all inspections, testing, and related construction documentation as described in this CQA Plan. The CQA Officer will be responsible for preparation of the construction acceptance report to certify substantial compliance with the engineering design. The CQA Officer shall be an Illinois Registered Professional Engineer.

The CQA Officer may delegate daily inspection, testing, and sampling duties to a qualified technician with experience in the assigned aspect of construction who will serve as the CQA Officer-In-Absentia (COIA). Although these duties may be delegated, the CQA Officer will retain the responsibility for these activities.

When a COIA is designated, the CQA Officer shall visit the construction site periodically during active periods of construction to personally observe the construction and documentation procedures. Also, at a minimum, the CQA Officer shall personally observe, on at least one occasion, each of the following major elements of landfill construction:

- ❑ Compaction of the subgrade and foundation to design parameters;
- ❑ Installation of underdrain system;
- ❑ Installation/testing of the compacted low permeability soil liner;
- ❑ Installation/testing of the geomembrane;
- ❑ Installation/testing of the leachate drainage and collection system;
- ❑ Application/testing of the final cover;
- ❑ Installation/testing of gas control facilities; and
- ❑ Construction of the ponds, ditches, and berms.

The CQA Officer shall be readily available for consultation, as needed.

2.3 CQA Officer-In-Absentia (COIA)

In the event that the CQA Officer is unable to be present to perform the requirements of this CQA Plan, the CQA Officer will designate a person to fulfill the duties of the CQA Officer and exercise professional judgment in the role of CQA Officer-In-Absentia (COIA). The COIA will not necessarily be an Illinois Registered Professional Engineer. The Officer-in-Absentia form provided in Section 21, or its equivalent, shall be completed in its entirety when a COIA is designated, and shall be included in the construction acceptance report.

The COIA will carry out daily inspection, testing, and sampling duties under the direct supervision of the CQA Officer. The COIA shall be a qualified technician with experience in the assigned aspect of construction. The COIA will prepare daily summary and inspection reports and transmit these routinely to the CQA Officer. The COIA will immediately notify the CQA Officer of any problems or deviations from design plans and specifications. The COIA will not have authority to approve any design or specification changes without the consent of the CQA Officer.

2.4 Soils Testing Laboratory

The Soils Testing Laboratory shall have experience in testing soils in accordance with standards developed by the American Society of Testing and Materials (ASTM), American Association of State Highway and Transportation Officials (AASHTO), United States Army Corp of Engineers (USCOE), and other applicable test standards. A third-party laboratory, not owned by the Operator or the Manufacturer will be used. The selected laboratory will be required to be responsive to the project needs by providing test results within reasonable time frames. Final laboratory reports will be certified by the Soils Testing Laboratory and submitted to the CQA Officer.

2.5 Geosynthetic Testing Laboratory

The Geosynthetic Testing Laboratory will have experience in testing geosynthetics in accordance with standards developed by the American Society of Testing and Materials (ASTM), Geosynthetic Institute (GSI), International Standards Organization (ISO), and other applicable test standards. A third-party laboratory not owned by the Operator or the manufacturer will be used. The selected laboratory will be required to be responsive to the project needs by providing test results within reasonable time frames. Final laboratory reports will be certified by the Geosynthetic Testing Laboratory and submitted to the CQA officer.

2.6 Construction Contractor

The Construction Contractor will be responsible for performing and controlling earthwork, construction, and piping installation, and to provide overall construction responsibility. The Construction Contractor will be experienced in solid waste landfill construction or similar type projects, knowledgeable about clay liner construction techniques, and familiar with geosynthetic installations. Selection of a qualified Construction Contractor will be at the Owner’s discretion.

2.7 Geosynthetics Installation Contractor

The Geosynthetic Installation Contractor (Installer) will be responsible for providing the materials, equipment, and personnel to install the required geosynthetic components. The Geosynthetics Installation Contractor will be trained and qualified to install the various required geosynthetic components. The Geosynthetics Installation Contractor will be approved and/or licensed by the manufacturer. Selection of a qualified Geosynthetic Installation Contractor will be at the Owner’s discretion.

2.8 Manufacturer(s)

The Manufacturers are responsible for manufacturing and/or fabricating their respective components in accordance with the design criteria, drawings, and specifications to the satisfaction of the CQA Officer and Operator. The Manufacturers are required to implement the MQA and MQC programs described in the specifications. The Manufacturers may implement their own supplemental quality assurance/quality control program for purposes of monitoring the manufacture or fabrication of their respective components.

3.0 PRECONSTRUCTION MEETING

Prior to construction commencing at the landfill facility, a preconstruction meeting shall be held. This meeting will include the parties involved in the construction, including the CQA Officer, COIA, construction and/or installation contractor, and Operator.

The objectives of this meeting include construction planning and coordination of tasks; identification of potential problems that might cause difficulties and delays in construction; proper interpretation of design intent by contractor(s); and to present the CQA Plan to all the parties involved. It is very important that the rules regarding documentation, reporting, testing, repair, and acceptance be understood by each party to this CQA Plan.

Specific topics considered for this meeting include the following:

- ❑ Review the construction plans, construction specifications, and CQA Plan. Review all critical design details of the project.
- ❑ Review measures for surface and storm water control, including but not limited to storm water diversion, erosion control measures, pumping locations, storm water retention, and discharge requirements.
- ❑ Review pending and approved IEPA modifications to the CQA Plan and develop any project specific addenda.
- ❑ Review the responsibilities of each party.
- ❑ Review lines of authority and communication.
- ❑ Review methods for documenting, reporting, and distributing documents and reports.
- ❑ Review the testing requirements, locations, and frequency for the soil and geosynthetic components.
- ❑ Construction procedures for the compacted low-permeability soil layer, including compaction and water content requirement, precautions to be taken to maximize bonding between lifts of compacted low-permeability soil, method for splicing liner and cover, precautions to minimize desiccation cracking, surface preparation and approval prior to geomembrane placement.
- ❑ Establish rules for writing on the geomembrane (i.e., who is authorized to write, what can be written, and in which color). Outline procedures for packaging and storing archive samples.
- ❑ Review the time schedule for all operations and hours of operations.
- ❑ Establish procedures for deployment of materials over completed geosynthetics.
- ❑ Observe where the site survey benchmarks are located, and review methods for maintaining vertical and horizontal control.
- ❑ Review permit documentation requirements.
- ❑ Review the survey documentation tables and plans that identify the locations where survey documentation information is required.
- ❑ Conduct a site walk-around to review material storage locations and general conditions relative to construction.
- ❑ Review geomembrane panel and seam layout drawings and numbering systems.

- ❑ Establish procedures for use of the geomembrane welding apparatus, if applicable.
- ❑ Finalize field cutout sample sizes.
- ❑ Review repair procedures.
- ❑ Review procedures for working in areas containing waste.

Unless otherwise agreed upon, the meeting will be documented by the CQA Officer, and minutes will be distributed to all parties involved in the construction project.

4.0 GENERAL CONSTRUCTION OBSERVATION AND DOCUMENTATION

This section describes general documentation procedures to be implemented including use of forms, identification and resolution of problems or deficiencies, and photographic documentation.

4.1 Daily Reports

A daily construction report shall be prepared by the CQA Officer, or under direct supervision of the CQA Officer, for each day of activity. Each report shall contain the following information:

- ❑ Date, project name, location, and report preparer's name and signature. Names and signatures of all inspectors on-site performing CQA under the supervision of the CQA Officer.
- ❑ Time work starts and ends each construction work day. Also identify the duration and reason for any work stoppages (i.e., weather delay, equipment shortage, labor shortage, unanticipated conditions encountered, etc.).
- ❑ Data on weather conditions including temperature, humidity, wind speed and direction, cloud cover, and precipitation.
- ❑ Construction Contractor’s work force, equipment in use, and materials delivered to or removed from job site.
- ❑ Chronological description of work in progress including locations and type of work performed.
- ❑ Summary of any meetings held and attendees.
- ❑ A description of all materials used and references or results of testing and documentation.
- ❑ Discussion of any problems/deficiencies identified and any corrective actions taken as described in Section 4.3 (Problem/Deficiency Identification and Corrective Action).
- ❑ Identification/list of laboratory samples collected, marked, and delivered to laboratories or clear reference to the document containing such information if samples were obtained.
- ❑ An accurate record of calibrations, recalibrations, or standardizations performed on field testing equipment, including any actions taken as a result of recalibrations. In addition, the results of other data recording such as geomembrane seaming temperatures shall be included or clearly referenced to the document containing such information, if applicable.
- ❑ Copies of each inspectors daily field data sheets.

Field data sheets shall be prepared daily by the COIA and contain the following information:

- ❑ Test or sample location and elevation
- ❑ Type of inspection
- ❑ The procedures used
- ❑ Test data
- ❑ Test results

- ❑ Personnel involved in the inspection and sampling activities
- ❑ Name of the COIA

4.2 Forms, Checklists, and Data Sheets

Additional forms may be developed during the course of the project to provide specific needs such as geomembrane inspections or simply to improve efficiency of data collection. Any new forms shall be approved by the CQA Officer prior to their use.

4.3 Problem/Deficiency Identification and Corrective Action

Problem and/or deficiency identification and corrective action will be documented in the Daily Summary Report when any construction material or activity is observed or tested that does not meet the requirements set forth in this CQA Plan. The Summary Report should clearly reference any other report, photograph, or form that contains data or observations leading to the determination of a problem or deficiency. Problem/deficiency identification and corrective action documentation may include the following information:

- ❑ A description of the problem or deficiency, including reference to any supplemental data or observations responsible for determining the problem or deficiency.
- ❑ Location of the problem or deficiency, including how and when the problem or deficiency was discovered. In addition, an estimate of how long the problem or deficiency has existed should be included.
- ❑ A recommended corrective action for resolving the problem or deficiency. If the corrective action has already been implemented, then the observations and documentation to show that the problem or deficiency has been resolved should be included. If the problem or deficiency has not been resolved by the end of the day upon which it was discovered, then the report will clearly state that it is an unresolved problem or deficiency.

The CQA Officer and the COIA will discuss the necessary corrective actions with the Owner and the Construction Contractor and implement actions, as necessary, to resolve the problem or deficiency as soon as possible. A description of such problems or deficiencies and corrective actions implemented will be provided in the Construction Documentation Report.

The CQA Officer, working with the Operator and Construction Contractor, will determine if the problem or deficiency is an indication of a situation that might require changes to the plans and specifications and/or the CQA Plan. Any revisions to the plans or specifications or the CQA Plan must be approved by the CQA Officer and the site Operator. CQA Plan modifications will be approved by the IEPA.

4.4 Photographic Documentation

Photographs shall be taken of each major element of the CQA process to document observations, problems, deficiencies, corrective actions, and work in progress. The following information should be documented in the daily report or a log book for each photograph:

- ❑ Date and time.
- ❑ Approximate location where photograph was taken, including information regarding the orientation of the photograph itself for proper viewing (i.e., looking south), if not

apparent from the content of the photograph.

- ❑ Description of the subject matter.
- ❑ Unique identifying number for reference in other reports.
- ❑ Name and signature of photographer.

4.5 Surveying

Documentation surveying requirements for each major landfill component are described in Sections 6.0 through 19.0. All required surveying will be performed under the direct supervision of the CQA Officer. All surveys will be based on survey control monuments to be established according to Part 811.104. The location of all field tests and samples will be recorded. Generally, these locations can be determined by reference to nearby construction stakes or markings; however, if such convenient reference is not readily available, the CQA Officer or the designated COIA is responsible to provide or request survey control.

5.0 CONSTRUCTION ACCEPTANCE REPORT

Following completion of construction of each major phase (or sub-phase), a Construction Acceptance Report will be prepared including certification by the CQA Officer that construction was completed in substantial conformance with the engineering design and applicable approvals. The report will be submitted to the IEPA, as required for operation approval.

The report will include the following information, at a minimum:

5.1 Narrative

A narrative description in chronological order for each of the major construction elements listed in Section 1.0. The narrative will include discussion of the following items:

- ❑ A physical description of the subject construction and a description of the construction procedures used.
- ❑ A comparison of testing requirements, as specified by the CQA Plan, to the testing actually performed.
- ❑ A comparison of acceptance criteria specified by the CQA Plan to the testing results actually achieved. Summaries of all test data (including sample and test locations) will be provided as well as copies of pertinent laboratory testing reports such as grain-size distribution curves, hydraulic conductivity test data, moisture- density curves, and geosynthetic test data.
- ❑ A comparison of surveying requirements specified by the CQA Plan to those performed, and an evaluation of conformance to specified thicknesses, lines, and grades. Survey data will be summarized and/or represented by drawings of record.
- ❑ Any deviation from the design plan or from the agency approval will be discussed including the reason and justification for the change.
- ❑ Any pertinent correspondence related to the construction will be referenced in the narrative and included in appendices.

5.2 Photographic Documentation

Photographic documentation will be included in an appendix. A sufficient number of photos will be included to provide a visual concept of each major component of landfill construction. Photographs may also depict testing and sampling procedures and construction procedures.

5.3 Summary Reports

Copies of all Daily Summary Reports will be provided in an appendix.

5.4 Drawings of Record

Drawings of Record for the construction may include the following Plan Sheets and contents, as applicable. When practical, each of these record drawings should show where samples are collected and/or tests were conducted, with a reference to test/ sample identification:

- ❑ Title Sheet - Project name, date, site location, preparer, Owner/Operator, certification, and drawing index.
- ❑ Subgrade Grades - Surveyed subgrade grade spot elevations, areas of over excavation, average depth of over excavation, locations of areas requiring placement of geosynthetics or crushed stone for dewatering, and locations of any areas requiring stabilization.
- ❑ Liner Grades - Surveyed top of liner grade spot elevations.
- ❑ Liner Geomembrane - Panel and seam locations, anchor trench locations, any pertinent testing locations, and penetration locations, including repairs.
- ❑ Leachate Drainage and Collection System - Surveyed top of drainage layer grade spot elevations, or measured thickness, location and slopes of leachate collection pipes, anti-seep collars, manholes, tanks, and loading facilities.
- ❑ Gas Control System – Surveyed locations of wells, laterals, and header piping with spot elevations as necessary, locations of air lines and condensate forcemain piping, locations of tanks, condensate collection points, and tie-in locations.
- ❑ Surface Water Drainage Facilities - Lines, grades, and spot elevations of surface water control facilities. Pipe locations, elevations, and any control devices will also be shown. If possible, this information may be incorporated into another Plan Sheet.
- ❑ Final Cover Low-Permeability Soil Layer - Surveyed top of low-permeability soil cover spot elevations.
- ❑ Final Cover Geomembrane - Panel and seam locations, any pertinent testing locations, and penetration locations, including repairs.
- ❑ Final Cover Drainage Layer - Surveyed top of granular layer, or limits of geocomposite if geosynthetic material is used.
- ❑ Final Cover Protective Layer - Top of protective layer grade spot elevations. Any surface water drainage or diversion facilities associated with the final cover.
- ❑ Details - Detail Plan Sheets will depict any necessary components, as necessary, to clearly document construction. Details may include, but may not be limited to: plan and profiles of manholes, tanks, piping and pump controls, liner penetrations, gas control system structures, and drainage structure controls.

6.0 SUBGRADE AND FOUNDATION

The liner subgrade will be established by excavating overburden soils to the designed subgrade grades.

6.1 Procedures and Observation

- ❑ In order to ensure a firm subgrade, the Contractor will proof-roll the subgrade if required by the CQA Officer. The COIA will observe the proof-rolling and note any areas that appear unacceptable or soft.
- ❑ Upon attainment of subgrade grades by excavation, the COIA will observe subgrade conditions and document unexpected conditions such as wet or unstable areas, permeable lenses, or standing or running water. The COIA will observe soil surfaces for joints, fractures, and depressions. These areas will be repaired as discussed below.
- ❑ Any unstable areas, permeable lenses, joints, or fractures encountered will be excavated at least 2 foot in depth and replaced with low-permeability soil. If required, dewatering, placement of geosynthetics, or placement of crushed stone to stabilize the subgrade undercut below 2 foot shall be at the direction of the CQA Officer.
- ❑ In the event that groundwater is encountered during excavation, the following procedures will be followed:
  - Excavating in the area will cease until the area can be assessed and mitigation measures implemented.
  - Zion Landfill will be notified by the contractor immediately.
  - The CQA Officer and an experienced geotechnical engineer will be notified immediately.
  - Based on recommendations by the geotechnical engineer, mitigation measures will be implemented (mitigation measures may include, but not be limited to perimeter dewatering, horizontal drains, and or drainage ditches). If groundwater is present in an amount that would impede construction of the liner, additional mitigation measures may be implemented to construct an underdrain system (see Section 6.2).
  - Upon stabilization of the uplift forces, subgrade grade excavation will be completed and the low-permeability soil liner will be placed.
  - Mitigation measures will be maintained during waste placement operations until sufficient overburden materials are in place in order to counteract hydrostatic uplift forces.
  - Any corrective actions taken under this section should be documented using the methods in Section 4.3.

6.2 Excavation

The following procedures will be followed prior to and during construction.

- ❑ All available geologic information, including boring logs and geologic cross sections, will be reviewed prior to excavation.
- ❑ Meetings will be scheduled on a regular basis between the Owner, contractor, and

CQA Officer to discuss elevations of the subgrade.

- Excavation depths will be monitored continuously to ensure subgrade grades are not over excavated.

In areas where groundwater is encountered which may be anticipated to impede construction of the liner, an underdrain system will be installed. The underdrain system is a 200-mil double-sided geocomposite, which consists of an HDPE Geonet with a 6 oz/yd^2 geotextile heat-bonded to both sides, and will be placed to intercept the encountered groundwater seepage. Groundwater will be transported via the geocomposite drainage layer to sumps which will be constructed similar to those constructed above the liner however, the sump will not be lined with a geomembrane liner. A geomembrane liner is not necessary due to the upward gradient and the fact that the groundwater will at no time come in contact with waste. The groundwater will be pumped up sideslope risers similar to those constructed above the liner and will discharge to the perimeter ditches.

Groundwater inflow may occur during periods of high water table. This inflow can be managed through the use of perimeter ditches and sumps. The sumps will be field located during construction. Sumps will be located in areas of groundwater seepage.

6.3 Sampling Requirements and Acceptance Criteria

- As discussed above, subgrade stability will be determined by visual observations of surface conditions under proof rolling with a loaded haul truck or scraper, with rutting less than four inches considered acceptable.
- Any subgrade areas requiring placement of compacted low-permeability soil for stabilization should follow the Quality Assurance requirements.
- One representative sample will be obtained from the subgrade/subbase soil areas and analyzed for each cell construction area.
    - The following laboratory analysis will be performed:
        - Shear Strength – ASTM D3080
    - The following represents the Acceptance Criteria:
        - Angle of Internal Friction and Cohesion shall be greater than or equal to the window of 24.1 degrees with 0 psf and 14.9 degrees with 45 psf. See Table 12 for a figure of the required window.

6.4 Surveying

Subgrade elevations will be surveyed on a 100-foot grid pattern at a minimum and any additional locations required to depict breaks in grade, toe, and top of sideslopes. In the alignment of undercuts for leachate collection lines, subgrade elevations will be surveyed at 50-foot intervals. The subgrade grades shall be equal to or lower in elevation than the design subgrade grades.

The limits of any subgrade stabilization or permeable lense removal and backfill will be surveyed and depicted on the Subgrade Grades record drawing plan sheet. The location of all field tests and samples will be recorded.

7.0 TEST LINER

A test liner has previously been constructed at the site and approved by the IEPA as meeting the requirements of 35 IAC Part 811.507. Additional test liner(s) will be constructed if the material properties of the borrow source substantively changes or there is a change in equipment or procedure. It should be noted that admixtures are not proposed at this time as part of the liner; however, a new test liner will be constructed if they are proposed in the future. If additional test liner(s) are required, they will be constructed and evaluated in accordance with the requirements of 35 IAC Part 811.507. The COIA will observe its construction and perform the required testing and sampling. The CQA Officer will inspect the construction and testing of the test liner to ensure that the requirements of Part 911.507(a) are met following the construction of the test liner. The CQA Officer will prepare a documentation report of the test liner construction and testing results for IEPA submittal prior to a full-scale low-permeability earth liner construction.

7.1 Test Liner Design

The test liner dimensions will be 100 feet in length by 50 feet in width and 5 feet thick. The liner will be constructed with a 2 percent slope across its width, and the final surface will be elevated approximately 0.5 foot above the existing ground surface to promote runoff. The widest piece of equipment to be used in liner construction is approximately 12 feet. The scraper, being the longest piece of equipment, is approximately 40 feet in length. The scraper will already be in motion when it approaches the test liner and operates at very low speeds when depositing soil; therefore, the testing area of the liner has been determined by establishing a buffer for edge effects equal to one half the length of a scraper and one half the width of equipment. This provides a testing area with dimensions of 38 feet by 60 feet.

7.2 Procedures and Observation

- ❑ A shallow excavation will be made to remove topsoil and simulate subgrade conditions. The subgrade will be proof-rolled and quantitatively evaluated for acceptance using the methods in Section 6.3.
- ❑ Low-permeability soil for construction of the test liner will be obtained from the same borrow source(s) or from excavation material, for the full-scale liner.
- ❑ The COIA will confirm the source and uniformity of the borrow source.
- ❑ The Construction Contractor will segregate and/or remove unsuitable soils as discussed in Subsection 8.1 (Low-Permeability Soils). Contractor methods will be evaluated for removal of stones which may cause damage to the liner or are greater than 2 inches in diameter within 6 inches of the final test liner surface.
- ❑ Low-permeability soil will be placed in loose lifts using scrapers or dozers. The effectiveness of scrapers performing this task will be evaluated by measuring loose lift thickness. The equipment will spread each lift to an approximate 9-inch thickness prior to compaction. Then, the compactor speed and number of passes required to achieve specified compaction will be evaluated. The test liner documentation report will discuss construction methods and propose a method for construction of the full scale liner.
- ❑ The test liner will be constructed to a minimum thickness of 5-feet.
- ❑ The final surface of the test liner will be compacted with a smooth drum roller. Then, the suitability of the surface relative to geomembrane placement will be evaluated.

- Moisture conditioning may be implemented at the direction of the CQA Officer to protect the completed test liner surface from desiccation, particularly if the in- field hydraulic conductivity testing has not been completed.
- The test liner will be abandoned following completion of all data collection upon notice by the CQA Officer.
- The low permeability soil material used for the construction of the test liner may be incorporated in the full-scale liner construction.

7.3 Sampling Requirements and Acceptance Criteria

Due to the relative size of the test liner, sampling frequencies are intensified solely for the purpose of demonstrating repeatability of results. The COIA will perform field tests and collect soil samples for laboratory analysis.

7.3.1 Field Testing

Parameter	**Method**
Moisture Content & Soil Density	ASTM D6938
Hydraulic conductivity	ASTM D6391-11

Field density and moisture content will be performed on each lift thickness of soil placed at the locations chosen by the CQA Officer. A properly calibrated nuclear density-moisture gauge will be used for field moisture and density determination. The COIA will select field density/moisture content test locations by random and judgmental processes. The testing frequency shall be no less than two tests per lift of earth liner placed.

In-field hydraulic conductivity testing will be performed on the final test liner surface at a minimum of three locations determined by the CQA Officer. Tests will be conducted in accordance with ASTM D6391-11. Extreme care will be used in conducting this testing as the procedure has inherent interferences that may adversely affect results and yield unrepresentative data. Such interference includes evaporation and inadequate seals between the permeameter and low-permeability soil. These factors will be closely monitored to verify test results.

The COIA shall record the approximate location of all field density and moisture content tests and hydraulic conductivity samples to a nominal accuracy of twenty-five (25) feet, referencing the project coordinate and elevation system, and depth according to the lift number.

7.3.2 Field Testing Acceptance Criteria

Acceptance criteria for density and moisture content will require soil compaction to a minimum of 95 percent of the Standard Proctor maximum dry density, or to a minimum of 90 percent of the Modified Proctor maximum dry density, at a moisture content equal to or greater than optimum. Field hydraulic conductivity will be required to be no greater than 1×10^{-7} cm/s.

7.3.3 Laboratory Testing

Undisturbed Sample Analysis

Samples for determining in-place properties will be collected by an appropriate method for obtaining intact, undisturbed samples. Two undisturbed samples per lift will be obtained. An undisturbed sample will be obtained on the final lift so each in-field hydraulic conductivity test can be compared to laboratory hydraulic conductivity results. The following laboratory analysis will be performed on each undisturbed sample:

Parameter	Test Method
Moisture Content and Dry Density	ASTM D2216
Atterberg limits	ASTM D4318
Grain Size Analysis*	ASTM D7928 (particle size smaller than no. 200 sieve)
	ASTM D6913 (particle size larger than no. 200 sieve)
Hydraulic conductivity	ASTM D5084 or SW846-EPA Method 9100

* The former grain size analysis standard (ASTM D422) was withdrawn by ASTM in 2016.

Representative Sample Analysis

A single representative (grab) sample will be obtained from the low-permeability soil borrow source and analyzed prior to construction. This will confirm soil characteristics and provide the maximum dry density value for compaction testing. A single sample will be adequate as only 740 cubic yards of in-place low-permeability soil will be required to construct the test liner.

The following laboratory analysis will be performed on the representative sample:

Parameter	Test Method
Moisture Density Relationship using Standard or Modified Proctor Compaction	ASTM D698 (or ASTM D1557)
Atterberg limits	ASTM D4318
Grain Size Analysis*	ASTM D7928 (particle size smaller than no. 200 sieve) ASTM D6913 (particle size larger than no. 200 sieve)
Soil Classification per USCS (Unified Soil Classification System)	ASTM D2487

Remolded Hydraulic Conductivity At 95 percent compaction and equal to or greater than optimum water content per Standard Proctor Method (ASTM D698) or 90 percent compaction and equal to or greater than optimum water content per Modified Proctor Method (ASTM D1557)	ASTM D5084 or SW846-EPA Method 9100

* The former grain size analysis standard (ASTM D422) was withdrawn by ASTM in 2016.

Laboratory Testing Acceptance Criteria

- ❑ Hydraulic conductivity shall be no greater than 1 x 10^{-7} cm/s (low-permeability soil liner only).
- ❑ Percent passing No. 200 sieve shall be at least 50%.
- ❑ Plasticity index shall be at least 4%, as long as hydraulic conductivity is no greater than 1 x 10^{-7} cm/s (low-permeability soil liner only).
- ❑ Atterberg Limits and Grain Size Analysis will be used to classify soils per the USCS. Low-permeability soils with USCS classification as CH, CL, or CL-ML are acceptable.

7.4 Surveying

Top and bottom of low-permeability soil liner elevations will be surveyed on a grid system with 25-foot intervals across the width of the test liner and 50-foot intervals across its length. The minimum acceptable liner thickness will be 5 feet. The location and elevation of all samples will be recorded.

8.0 LOW-PERMEABILITY SOILS

Low-permeability soil refers to the compacted low-permeability soil components of the composite liner (i.e., floor and sidewalls), the composite cover designs, compacted foundation fill, and low-permeability fill for containment berms, temporary and permanent berms, stormwater basin dikes, and fill embankments. The composite liner design consists of (from bottom to top) a 5-foot thick compacted low-permeability soil layer (low-permeability earth liner) overlain with a 60-mil HDPE geomembrane, cushion geotextile, 1-foot thick granular drainage layer, and filter geotextile. The composite cover design consists of (from bottom to top) a 2-foot-thick compacted low-permeability soil layer (final cover barrier soil), a 40-mil LLDPE geomembrane, a geocomposite drainage layer, and a 3-foot-thick vegetative protective layer.

8.1 Procedures and Observation

The COIA will observe all compacted low-permeability earth liner, final cover barrier soil, compacted foundation fill, low-permeability containment berm, temporary and permanent berm, and stormwater basin dike soil construction activities and document relevant observations to support certification of the following requirements:

- ❑ Compaction equipment similar to that used in the test fill shall be used in the actual, full-scale compacted low-permeability earth liner and final cover barrier soil.
- ❑ The same compaction procedures employed in the test fill shall be utilized for the actual low-permeability earth liner, compacted foundation fill, final cover barrier soil, and low-permeability berms and basins, such as the number of passes, speed, and uniformity of coverage.
- ❑ The COIA will confirm the source and uniformity of the low-permeability borrow soils. Soil excavation and placement will be monitored for segregation and removal of unsuitable material and for changes in soil type, color, texture, and moisture content. Additional characterization and testing will be completed if borrow soils for the conditions anticipated during design change from those used in the test pad.
- ❑ The Construction Contractor will segregate and/or remove unsuitable materials such as granular soils, silty or sandy clays not meeting acceptance criteria, boulders, cobbles, and organic material. Additionally, the Construction Contractor will remove any stones greater than 2 inches in diameter observed in the low-permeability earth liner and final cover barrier soil placed within 6 inches of the geomembrane liner. Prior to compaction of the final lift of low-permeability soil, the material will be checked for the presence of sharp objects and angular stones by visual inspection. Any stones or clods larger than 4-inches in least dimension will be removed prior to placing compacted foundation fill.

Following compaction of the final lift, the material will be checked again for the presence of sharp objects and angular stones by visual inspection. Any stones observed will be removed.

- ❑ The COIA will measure field densities and moisture contents, to document that the compacted low-permeability earth liner is in substantial conformance with the placement specifications and that soil placement has been conducted in a manner to achieve a uniform, homogeneous mass.
- ❑ Any areas of unacceptable compaction density or moisture content will be documented by the COIA. Corrective action will consist of moisture conditioning of

the soil and/or additional compactive effort as necessary. Following corrective actions, such areas will be retested. Rework and testing will continue until satisfactory conditions have been achieved.

- Loose lift thicknesses for low-permeability soil compaction will not exceed 9 inches, or the thickness of the compactor foot. If soil is deposited in thickness exceeding 9 inches, dozers will be used to spread the soil to a 9-inch thickness prior to compaction. This will assure adequate reduction of clod size and provide a thin enough layer to achieve required compaction throughout the lift.
- If necessary, surfaces of liner to receive successive lifts of low-permeability soil will be moisture conditioned either by scarification and addition of water where desiccated, or by discing and air drying where too wet to promote effective bonding of lifts. Water will be applied with a spray bar applicator by a tank truck or equivalent methods to achieve uniform distribution following scarification.
- Low-permeability soil compaction will be performed in a manner to achieve continuous and complete keying together of all segments of low-permeability soil construction. Stepped joints will be utilized to connect any lateral segments of low-permeability soil construction.
- Preconstruction planning will be done to sequence construction activities which minimizes the length of time any completed low-permeability soil surfaces are exposed prior to receiving protective cover. Protective cover will be provided by installation of the geomembrane. Surfaces will be maintained until protective cover is placed.
- Construction of the composite liner system, consisting of both the floor and sidewalls, will be done in accordance with the low permeability earth liner specifications and the minimum liner strength will be consistent for both the floor and sidewalls.
- Construction of the low-permeability soil layers or features will proceed only during favorable climatic conditions.
- No frozen soils will be used for low-permeability soil construction. Any frozen soils in the compaction work area will be removed.
- The final surface of the low-permeability earth liner and final cover barrier soil will be compacted with a smooth drum roller to provide a level surface for installation of the geomembrane liner. Preconstruction planning will be done to minimize the need for traffic over the completed liner surface. Heavy trucking of materials and cleated equipment will not be allowed directly on completed liner surfaces. If this is unavoidable, an evaluation will be made upon termination of the haul route to determine if the liner should be reconstructed or repaired in such areas. Floatation-type all-terrain vehicles will be used to assist in deployment of the geomembrane liner to avoid disruption of the completed low-permeability soil liner surface.
- When the completed compacted low-permeability soil is exposed prior to geomembrane deployment, moisture conditioning of the liner surface will be employed as necessary to prevent desiccation.

8.2 Sampling Requirements and Acceptance Criteria

Field and laboratory sampling frequencies are based on proportionate sampling of construction areas or volume of material placed. This section describes required analysis, methods, sample frequency, and acceptance limits. The COIA will perform field tests and collect soil samples for laboratory analysis.

8.2.1 Field Testing

The following field testing methods will be used by the COIA during construction of low-permeability soils:

Parameter	Method
Moisture Content & Soil Density	ASTM D6938

Field density and moisture content tests will be performed at a minimum frequency of 5 tests per acre per lift (6-inch) for the final cover barrier soil and for the low-permeability earth liner. Field density and moisture content tests will be performed at a minimum frequency of 1 test per 1,000 cubic yards for the compacted foundation fill, containment berms, temporary and permanent berms, stormwater basin dikes, and fill embankments. At a minimum, at least one field density/moisture content test will be conducted per lift and at least one test per day of compacted low-permeability soil construction. This sampling distribution will confirm that compaction is spatially uniform. A nuclear density-moisture gauge will be used for field moisture and density determination.

8.2.2 Field Testing Acceptance Criteria

Acceptance criteria for field density and moisture content of the compacted foundation fill and low-permeability earth liner will require soil compaction to a minimum of 95 percent of the Standard Proctor maximum dry density, or to a minimum of 90 percent of the Modified Proctor maximum dry density, at a moisture content equal to or greater than optimum. The acceptance criteria for field density and moisture content of the final cover barrier soil and the containment berms, temporary and permanent berms, stormwater basin dikes, and fill embankments will require soil compaction to a minimum of 90 percent of the Standard Proctor maximum dry density, or to a minimum of 85 percent of the Modified Proctor maximum dry density. Visual inspections will be performed to verify that the soil is free of organics (roots, leaves, grasses, etc.) and that the maximum size of the stones/clods in the soil is approximately 3 inches.

8.2.3 Laboratory Testing

Routine laboratory testing of the compacted low-permeability soils will be performed on samples from the low-permeability soil borrow area and in-place low- permeability soils collected by the COIA. Samples for determining in-place properties will be collected by an appropriate method for obtaining intact, undisturbed samples. Soil characteristics will be determined from representative samples.

Undisturbed Sample Analysis

Laboratory hydraulic conductivity of the in-place low-permeability earth liner will be completed:

Hydraulic conductivity	ASTM D5084 or SW 846-EPA Method 9100

The hydraulic conductivity testing frequency is based on the USEPA Technical Guidance Document, which states that if a test pad has demonstrated that the field-scale hydraulic conductivity is satisfactory, the QA program for the actual soil liner should focus on establishing that the actual liner is built of similar materials and to equal or better standards compared to the test pad, and that laboratory hydraulic conductivity testing is not necessary. This Section describes the procedures to be implemented to ensure that the actual liner is built of similar materials and to equal or better standards compared to the test pad. Given the historical consistency of the soils available on-site, an industry standard hydraulic conductivity testing frequency of 1 per 10,000 cubic yards of low-permeability soil placed is included in this CQA Plan as an added measure of liner performance. At the discretion of the CQA Officer, the hydraulic conductivity testing frequency may increase if borrow sources change.

The CQA Officer shall also have the discretion to forgo Internal Shear Strength Testing provided the test liner results satisfy the material requirements specified in Table 13.

Representative Sample Analysis

Representative (grab) samples will be obtained on the basis of three criteria. First, an initial sample will be obtained from the low-permeability soil borrow source and analyzed prior to construction. This will confirm soil characteristics and provide an initial maximum dry density value for compaction testing. The representative sample obtained for the test liner may be used to satisfy this initial sample requirement. Second, routine samples will be obtained for every 10,000 cubic yards placed. Third, in the event that changes in physical appearance or soil characteristics are observed, a sample will be obtained and analyzed. The maximum dry density value used for compaction testing may be adjusted during the course of liner construction based on the results of the above sampling.

The following laboratory analyses will be performed on all representative samples obtained:

Parameter	**Test Method**
Moisture-Density Relationship using Standard or Modified Proctor Compaction	ASTM D698 or ASTM D1557
Atterberg Limits	ASTM D4318
Grain-size Analysis*	ASTM D7928 (particle size smaller than no. 200 sieve) ASTM D6913 (particle size larger than no. 200 sieve)
Soil Classification per USCS (Unified Soil Classification System)	ASTM D2487

* The former grain size analysis standard (ASTM D422) was withdrawn by ASTM in 2016.

At a minimum, one representative sample per soil source per construction season shall be collected be analyzed for remolded hydraulic conductivity at 95% of the Standard Proctor density (or 90 of the Modified Standard Proctor density) for the low-permeability earth liner and compacted foundation fill, and 90% of the Standard Proctor density (or 85% of the Modified Proctor density) for the final cover barrier soil and detention basin sidewalls as follows:

Remolded Hydraulic Conductivity	ASTM D5084 or SW846-EPA Method 9100

Interface shear testing of the low-permeability earth liner and final cover barrier soil to the geosynthetics will also be completed per ASTM D5321. Testing shall be conducted at least once prior to use and upon change in materials (including soil type) comprising the interface, but no more than once per construction season. The CQA Officer shall determine if a change in soil type has occurred that warrant interface shear testing of materials that interface with that soil type. See Table 12 for the required specifications.

Laboratory Testing Acceptance Criteria

- Hydraulic conductivity shall be no greater than 1 x 10^{-7} cm/s for low-permeability earth liner and compacted foundation fill.
- Percent passing No. 200 sieve shall be at least 50% for the low-permeability earth liner.
- Hydraulic conductivity shall be not greater than 1 x 10^{-5} cm/s for final cover barrier soil and detention basin sidewalls, as required by stormwater detention basin design details.
- Percent passing No. 200 sieve shall be at least 20% for final cover barrier soil.
- Plasticity index shall be at least 4% for low-permeability liner, as long as hydraulic conductivity is no greater than 1 x 10^{-7} cm/s.
- Plasticity index shall be at least 4% for stormwater detention basin sidewalls, as long as hydraulic conductivity is no greater than 1 x 10^{-5} cm/s.
- Plasticity index shall be at least 4% for the final cover barrier soil. PI less than 4% may be acceptable, as long as hydraulic conductivity is no greater than 1 x 10^{-5} cm/s.
- Internal shear strength of the low-permeability soils must meet the shear strength window requirements in Table 13. The average of the samples shall be used to determine compliance with the project specifications, however no single test shall be less than 75% of the specified strength value.
- Atterberg Limits and Grain Size Analysis will be used to classify soils per the USCS. Clay soils with USCS classification as CH, CL, or CL-ML are acceptable for low-permeability earth liner material. Soils with USCS classification as CH, CL, CL-ML, ML, SC, or SM/SC are acceptable for the final cover barrier soil material and for the detention basin sidewall material, provided they meet the hydraulic conductivity specification.

8.3 Surveying

The top of low-permeability soil liner and final cover barrier soil will be surveyed on the same 100-foot grid pattern and other locations surveyed for subgrade grades. Other locations include breaks in grade, toe of slope, and top of sideslopes. In the alignment of undercuts for leachate collection lines, top of liner elevations will be surveyed at 50-foot intervals. Vertical survey tolerance will be 0.0 to +0.1 foot, and horizontal tolerance will be 0.5 foot. The low-permeability soil liner thickness will be determined at all surveyed locations and reported in table fashion. The minimum acceptable low-permeability earth liner thickness will be 5 feet perpendicular to the slope. The minimum acceptable final cover barrier soil thickness will be 2 feet perpendicular to the slope. The location and elevation of all samples will be recorded. Devices may be employed to document final cover barrier soil thickness.

9.0 GENERAL SOILS

General soils will be used for construction of the final cover protective cover soil layer, which consists of at least 36 inches of fill with the upper 6 inches capable for supporting vegetation. Stormwater berms are also to be constructed as protective cover soil. General soils may be any inorganic soil, except rock, and will be obtained from on-site stockpiles or directly from the subgrade excavation. Generally, these soils will consist of segregated excavation soils that do not meet the low-permeability soil liner soil specifications. For general soils used for construction of final cover protective cover soil layer, the first lift above the geosynthetics in the final cover will not contain stones greater than 2-inches diameter or other sharp objects that could damage the underlying geosynthetics, and the upper 6-inches will consist of natural, fertile top soil. Alternatively, the upper 12-inches of the cover will be amended with fertilizer or other approved material to ensure turf establishment. High odor potential materials will not be used to amend protective cover soils. Seeding, fertilizing, and mulching of general soils for establishment of vegetation is discussed in Section 18.0.

9.1 Procedures and Observation

The COIA will observe general soil placement activities and document relevant observations to support certification of the following requirements:

- ❑ The COIA will confirm the source and uniformity of general soils used. Soil excavation and placement will be monitored for segregation and removal of unsuitable material and for changes in soil type that may affect maximum dry density values used for determining percent compaction.
- ❑ The Construction Contractor will segregate and/or remove unsuitable materials such as boulders and organic material.
- ❑ General soils used for the final cover protective layer construction shall not be compacted; however, loose lift thickness shall not exceed 36 inches.
- ❑ Confirm that the soil over geosynthetic materials on the final cover sideslopes is placed from bottom of the slope upwards toward the top of the slope.
- ❑ No frozen soils will be used for general fill construction.
- ❑ Prior to seeding, the final protective layer will be worked to prepare a suitable seed bed.
- ❑ Fertilizing, seeding, and mulching will be performed in a timely manner.

9.2 Sampling Requirements and Acceptance Criteria

Field and laboratory sampling frequencies are based on proportionate sampling of construction areas or volume of material placed. This Section describes required analysis, methods, sample frequency, and acceptance limits. The COIA will perform field tests and collect soil samples for laboratory analysis. General soils placed for the final cover protective cover soil layer are not to be compacted, and thus field testing, sampling, and laboratory analysis will not be conducted.

9.2.1 Field Testing

No field testing will be required for the protective cover soils.

9.2.3 Laboratory Testing

Laboratory testing of the protective cover soil will be performed on representative samples from the general fill source and on representative samples of in-place fill collected by the COIA.

Representative Sample Analysis

Representative (grab) samples will be obtained for an initial sample will be obtained from the general fill source and analyzed prior to construction. In the event that changes in physical appearance or soil characteristics are observed, a sample will be obtained and analyzed.

Parameter	**Test Method**
Soil Classification per USCS	ASTM D2487(Unified Soil Classification System)

Additionally, interface shear testing of the protective cover soil to the geocomposite drainage layer in the final cover will be completed per ASTM D5321. Testing shall be conducted at least once prior to use and upon changes in material comprising the interface, but no more frequently than during any 18-month period. See Table 12 for the required specifications and acceptable window.

9.3 Surveying

The top of the protective cover grades will be surveyed on the same 100-foot grid pattern and other locations surveyed for top of final cover barrier soil grades. Other locations include breaks in grade and toe, and top of sideslopes. Vertical survey tolerance will be 0.0 to +0.1 foot, and horizontal tolerance will be 0.5 foot. The protective cover thickness will be determined at all surveyed locations and reported in table fashion. The minimum acceptable protective cover thickness will be 3 feet normal to the slope. Devices may be employed to document protective cover thickness.

10.0 GRANULAR SOILS

Granular soils refer to materials to be used as the granular drainage layer on the landfill base overlying the geotextile and geomembrane or coarse aggregate to be used for transmission of leachate and structural support of leachate collection pipes. All granular soils should be rounded to sub-angular.

10.1 Procedures and Observation

The COIA will observe granular soil placement activities and document relevant observations to support certification of the following requirements:

- ❑ The COIA shall periodically observe loads of granular soils for general conformance to material specifications and may randomly sample questionable loads. The COIA will perform routine conformance sampling.
- ❑ No tracked or rubber-tired equipment will travel directly on the geomembrane. Only low-ground pressure equipment may operate over the geomembrane when there is a 12-inch minimum layer of granular drainage material in-place. Procedures for deployment of pipe, sand, coarse aggregate, and/or geotextiles overlying any placed geomembranes will be planned at the Pre-Construction Meeting. No equipment shall apply a ground pressure greater than 5 psi on the geomembrane. Any special requirements for geomembrane protection and equipment necessary to deploy materials must be approved by the CQA Officer.
- ❑ In the Site 2 North Expansion a 12 oz/yd^2 geotextile cushion will be placed between the geomembrane and granular drainage layer and coarse aggregate in leachate collection lines, and an 8 oz/yd^2 geotextile filter will be placed on top of the granular drainage layer and coarse aggregate to minimize the entry of fines into the leachate collection system.
- ❑ A minimum of 6 inches of stone shall be placed under leachate collection pipes prior to pipe placement, and a minimum of 6 inches of stone shall be placed over the top of leachate collection pipes.
- ❑ Verify that the granular drainage layer thickness is 1 foot nominal to the surface.
- ❑ If granular soils are stockpiled on-site prior to use, measures should be taken to minimize contamination by fines such as wind-blown particles and surface soils during loading operations.
- ❑ Verify that the coarse aggregate (pipe bedding material) directly abuts the leachate collection layer placed during a preceding phase of construction and that any previously placed rainflap has been removed.
- ❑ Verify that the granular drainage layer (drainage layer material) directly abuts the leachate drainage layer placed during a preceding phase of construction and that any previously placed rainflap has been removed.

10.2 Sampling Requirements and Acceptance Criteria

Field sampling and laboratory testing frequencies are based on proportionate sampling of construction areas or volume of material placed. This section describes the required analysis, methods, sampling frequency, and acceptance limits. The COIA will collect soil samples for laboratory analysis.

10.2.1 Field Testing

No field testing will be required for granular soils. However, as above, the COIA will perform visual inspection of granular soils for conformance to material specifications and may randomly sample questionable loads, per ASTM D4288.

10.2.2 Laboratory Testing

Representative (grab) samples will be obtained from the proposed granular soil source prior to the delivery of any material. The source sampling frequency will be dependent on the apparent uniformity of the source and must be approved by the CQA Officer.

Grab samples of granular soils placed will be collected and analyzed as follows:

Soil Type	Frequency	Parameter	Test Method
Drainage Layer Material	1 test per source per phase	Grain size* (particle size larger than No. 200 sieve)	ASTM D6913
Drainage Layer Material	1/5,000 CY	Hydraulic conductivity	ASTM D2434
Drainage Layer Material	1/5,000 CY	Soil Class. per USCS	ASTM D2487
Pipe Bedding Material	1 test per source per phase	Grain size* (particle size larger than No. 200 sieve)	ASTM D6913
Pipe Bedding Material	1 test per source per phase	Soil Class. per USCS	ASTM D2487

* The former grain size analysis standard (ASTM D422) was withdrawn by ASTM in 2016.

Additionally, interface shear testing of the granular drainage layer and the cushion geotextile will be completed. This will be completed per ASTM D5321. Testing shall be conducted at least once prior to use and upon change in materials comprising the interface, but no more frequently than once during any one construction season. See Table 12 for the required specifications and acceptable windows.

Laboratory Testing Acceptance Criteria

For laboratory testing acceptance criteria of the granular drainage layer material, see Table 13.

10.3 Surveying/Thickness Determination

The finished elevation of the granular drainage layer will be documented by one of two methods to verify its thickness: survey on the same 100 foot grid as the final low-permeability soil liner surface, or physical measurement of the in-place thickness on a maximum 100 foot grid. The leachate collection pipe alignments shall be documented at locations of pipe fittings and intersections (e.g. wyes and tees). Stone placed along leachate collection pipe alignments will be surveyed for elevation prior to pipe placement and following pipe backfilling at 50-foot intervals to document the thickness of stone placed below pipe inverts and above the top of pipe.

11.0 GEOMEMBRANES

This section of the CQA Plan applies to the high density polyethylene (HDPE) geomembrane used in the composite liner and the linear low density polyethylene (LLDPE) geomembrane used in the final cover system.

The geomembrane will be supplied to the site in factory rolls. No factory seams will be used to prepare larger panels of geomembrane for delivery to the site. This CQA Plan, therefore, does not contain any QA/QC requirements for factory seaming.

This section is divided into four major subheadings which cover the QA requirements for the Pre-Installation (includes Resin Manufacturers and Geomembrane Manufacturers), Installation, Field Seaming, and Post-Installation (includes the final examination of the geomembranes prior to placing the appropriate material above the geomembrane). The terms Pre-Installation, Installation, Field Seaming, and Post-Installation are applicable only to the geomembrane installation and do not apply to the overall construction of the landfill facility.

11.1 Pre-Installation

This section describes the quality control measures that are applicable to the polyethylene (PE) Resin Manufacturers, Geomembrane Manufacturers, and finished geomembrane roll delivery to the site prior to installation.

The geomembranes must be fabricated from polyethylene resin, and the fabricated geomembrane must be classified as Type III Class C Category 4 or 5 as defined by ASTM D1248. (Note: these classifications are based on tests performed on the finished product, not the polyethylene resin used to fabricate the geomembrane.)

11.1.1 Manufacturing

Material Specifications

The following list specifies the required geomembrane materials for liner and final cover construction:

Composite liner on floor and sideslopes 3:1	60-mil Textured HDPE
Final cover on plateau and sideslopes 4:1	40-mil Double-Sided Textured LLDPE

The CQA Officer will confirm that the geomembrane utilized has adequate interface fiction properties based upon the actual materials/products that are used for construction.

Quality Control Requirements

Prior to the delivery of any geomembrane rolls to the site, the Geomembrane Manufacturer will provide the CQA Officer with the following information:

- ❑ The resin supplier, location of supplier's production plant(s), and resin brand name and lot number.

- ❑ Any test results conducted by the Geomembrane Manufacturer and/or the Resin Manufacturer testing laboratories to document the quality of the resin used in fabricating the geomembrane.
- ❑ The Quality Control Plan that the Geomembrane Manufacturer will be using for the geomembrane being supplied.
- ❑ Every roll of geomembrane for delivery to the site must be manufactured and inspected by the Geomembrane Manufacturer according to the following requirements:
    - First quality polyethylene resin must be used.
    - The resin shall contain no more than 10% rework (which must originate from the same resin type as the parent material).
    - No post-consumer resin of any type shall be used.
    - Natural resin (without carbon black) shall meet the requirements for density, melt flow index, and oxidative induction time (OIT) as listed on Tables 1 and 3 for HDPE and LLDPE, respectively.
    - The geomembrane must contain no more than a maximum of 1 percent by weight of additives, fillers, or extenders, excluding carbon black.
    - The geomembrane must have no striations, roughness (except for where the textured geomembrane is specified), or bubbles on the surface.
    - The geomembrane must be free of holes, blisters, undispersed raw materials, or any other sign of contamination by foreign matter.

The Geomembrane Manufacturer will routinely perform specific gravity (ASTM D792) tests on the raw resin to document the quality of the resins used to manufacture the geomembrane rolls designated to this project. The results will be submitted to the CQA Officer.

Manufacturer's Certification

The Geomembrane Manufacturer will provide certification, based on tests performed in accordance with Tables 1 and 3 (see Section 20) by either the Geomembrane Manufacturer's laboratory or other outside laboratory contracted by the Geomembrane Manufacturer, that the geomembrane supplied under this CQA Plan will meet the specifications listed in Tables 1 and 3.

Additionally, the Manufacturer shall provide certification that the Manufacturer's Quality Control Plan was (or will be) fully implemented for the geomembrane material supplied under this CQA Plan. The Manufacturer shall provide documentation to verify results of the Manufacturer's Quality Control Plan implementation if requested by the CQA Officer.

11.1.2 Delivery, Handling, and Storage of Geomembrane Roles

The geomembrane will be protected during shipment from excessive heat or cold, puncture, cutting, or other damaging or deleterious conditions. The geomembrane rolls will be stored on-site in a designated area and will be protected from long-term ultraviolet exposure prior to actual installation.

Each geomembrane roll will be marked by the Geomembrane Manufacturer with the following information on a durable gummed label, or equivalent, on inside of core:

- ❑ Name of manufacturer
- ❑ Product type and identification number (if any)
- ❑ Batch lot number
- ❑ Nominal product thickness
- ❑ Date of manufacture
- ❑ Roll number
- ❑ Roll length and width

When cores are required for preparing geomembranes for shipment, the contractor shall require the Manufacturer to use cores with sufficient crushing strength to avoid collapse or other damage while in use.

The following practices should be used as a minimum in receiving and storing geomembrane rolls in the designated storage area at the job site:

- ❑ The Installer shall be responsible for unloading, handling and storing all materials, supplies, and equipment in accordance with the Manufacturer's recommendations.
- ❑ While unloading or transferring the geomembrane rolls from one location to another, prevent damage to the geomembrane itself. The preferred method involves use of a spreader-bar, straps, and a loader. Do not drag rolls.
- ❑ Store the geomembrane rolls to ensure that they are adequately protected from the following:
  - Equipment damage
  - Strong oxidizing chemicals, acids, or bases
  - Flames including welding sparks
  - Temperatures in excess of 160°F
  - Soiling

The COIA will observe and document, throughout the pre-installation, installation, and post-installation periods that the Installer provides adequate handling equipment for moving geomembrane rolls and that the equipment and the handling methods used do not pose unnecessary risk of damage. The Installer is responsible for means and methods to implement the work.

The Installer will be responsible for assuring that all materials installed meet specifications. The COIA will maintain a log of geomembrane roll deliveries. The following information, at a minimum, will be recorded on the log for each shipment received at the job-site:

- ❑ Date of receipt of delivery at job-site
- ❑ For each geomembrane roll the following information will be noted:
  - Roll number
  - Batch lot number

11.2 Installation

This section includes discussions of geomembrane roll testing requirements, earthwork required for geomembrane placement, placement of the geomembrane, defects and repairs of geomembranes, and requirements applicable to other materials in contact with the geomembranes.

All parties involved in the installation of the geomembrane should be familiar with geomembranes and should emphasize protection of the geomembrane from damage during construction activities.

11.2.1 Test Methods

Geomembrane roll samples will be collected by the COIA as per the testing frequency mentioned in Material Acceptance Specifications Tables included in Section 20 of this CQA Plan. At least one sample shall also be obtained for each geomembrane production batch in each shipment. The Installer shall not ship to, nor receive at the site, geomembrane from more than two production batches in any single shipment without the prior written approval of the CQA Officer.

Samples will be 3 feet long by the full width of the roll and will not include the first 3 feet of any roll. Since machine direction for geomembrane rolls is the direction that the material comes off the roll, machine direction for any sample will always be along the 3-foot-length dimension of the sample.

Tables 1 and 3 in Section 20 list the tests and the test methods to be performed on the HDPE and LLDPE geomembrane roll samples. Specifications and methods used in evaluating the results are discussed below under Procedures for Determining Geomembrane Roll Test Failures. Unless specified, preparation of sample specimens will be performed in accordance with the referenced test method. Results for tear resistance and each of the tensile property tests will be reported for both the machine and cross direction.

Interface Shear Testing

The Operator will coordinate with the Geomembrane Manufacturer to submit a representative sample of the geomembranes and other applicable materials (e.g. low-permeability earth liner/final cover barrier soil materials, granular drainage layer materials, and geocomposite drainage layer materials) to the Geosynthetic Testing Laboratory for shear testing.

The following interfaces will be interface direct shear tested prior to each phase of the Geomembrane installation:

- ❑ Double-sided Geocomposite Drainage Layer vs. Final Cover 40-mil Textured LLDPE Geomembrane.
- ❑ Final Cover 40-mil Textured LLDPE Geomembrane vs. Final Cover Barrier Soil.
- ❑ 60-mil Textured HDPE Geomembrane vs. Low-permeability Earth Liner.
- ❑ 60-mil Textured HDPE Geomembrane vs. 12 oz Cushion Geotextile.

The Geomembrane interface shear testing combination shall be conducted based on the permitted design material at least once prior to first use and upon a change in materials comprising the interface (change in Manufacturer(s), material or manufacturing process).

Geomembrane-Earth Liner interface shear testing shall be conducted prior to each phase of Geomembrane installation, but no more than once per construction season. The interface shear testing frequency can be relaxed to once per 12 acres of additional installed liner for interfaces which have demonstrated compliance with the specified minimum interface adhesion and friction angle (or secant angle) criteria during each of the three most recent interface shear tests that were performed on different lots of geosynthetic materials. The relaxed testing frequency only applies when the materials comprising the interfaces have not changed, e.g. the earth materials have not changed appreciably and are from the same source as previously tested (i.e. the same borrow pit for imported material and the same geological unit for earth materials obtained onsite). The geosynthetic materials also must be of the same type and manufacturing process, and sourced from the same Manufacturer as materials which were previously tested.

Geomembrane-Cushion Geotextile interface shear testing shall be conducted at least once prior to first use and upon a change in materials comprising the interface (change in Manufacturer(s), materials or manufacturing process). Interface shear testing shall be conducted prior to each phase of installation along the landfill sideslopes, but need not be tested more than once per construction season. The interface shear testing frequency can be relaxed to once every 48 months for materials which have demonstrated compliance with the specified minimum interface adhesion and friction angle (or secant angle) criteria during each of the three most recent interface shear tests that were performed on different lots of geosynthetic materials. The relaxed testing frequency only applies when the materials comprising the interfaces have not changed, e.g. are from the same Manufacturer(s), and are of the same type and manufacturing process as materials which were previously tested.

Geomembrane-Final Cover Barrier Soil interface shear testing shall be conducted prior to each final cover construction event of Geomembrane installation on the 4:1 (horizontal to vertical) final cover slopes after the effective date of this CQA Plan, but need not be retested more than once per construction season.

Geomembrane-Geocomposite Drainage Layer interface shear testing shall be conducted at least once prior to first use and upon a change in materials comprising the interface (change in Manufacturer(s), materials or manufacturing process). Interface shear testing shall be conducted prior to each phase of installation along the landfill sideslopes, but need not be tested more than once per construction season. The interface shear testing frequency can be relaxed to once every 48 months for materials which have demonstrated compliance with the specified minimum interface adhesion and friction angle (or secant angle) criteria during each of the three most recent interface shear tests that were performed on different lots of geosynthetic materials. The relaxed testing frequency only applies when the materials comprising the interfaces have not changed, e.g. are from the same Manufacturer(s), and are of the same type and manufacturing process as materials which were previously tested.

All interface shear testing results shall meet the window requirements specified in Table 12.

Role of Testing Laboratory

The Geosynthetic Testing Laboratory will be responsible for performing the tests on samples submitted to them as described above under Test Methods. Results of tests performed will be reported to the CQA Officer and the COIA.

Retesting of geomembrane rolls for quality assurance purposes, because of failure to meet any or all of the acceptance specifications listed in Tables 1 and 3 (see Section 20), can only be authorized by the CQA Officer.

The Geomembrane Manufacturer and/or Installer may perform their own tests according to the methods and procedures defined in Tables 1 and 3; however, the results will only be applicable to their own quality control needs. These results will not be substituted for the quality assurance testing described herein.

Procedures for Determining Geomembrane Roll Test Failures

Tables 1 and 3 (see Section 20) list the acceptance specifications for the HDPE and LLDPE geomembranes. These tables apply to both textured and nontextured geomembranes. For tests where results are reported for both machine and cross direction, each result will be compared to listed specification to determine acceptance.

The values listed in the acceptance specifications of Table 1 are from GRI GM-13 Revision 16. The values listed in the acceptance specifications of Table 3 are from GRI GM-17 Revision 14. If the specifications in GM-13 and GM-17 are further revised in the future by GRI, the revised specifications will be used.

The following procedure will be used for interpreting results:

- ❑ If the test values meet the stated specifications in Tables 1 and 3 (see Section 20), then the roll and the lot will be accepted for use at the job-site. If the sample represents all rolls from an entire shipment, then the entire shipment will also be considered accepted.
- ❑ If the result does not meet the specifications, then the roll and the batch may be retested using specimens either from the original roll sample or from another sample collected by the COIA. For retesting, two additional tests will be performed for the failed test procedure. Each additional test will consist of multiple specimen tests if multiple specimens are called for in the test procedure. If both of the retests are acceptable, then the roll and batch will be considered to have passed this particular acceptance test; if either of the two additional tests fail, then the roll and batch will be considered unsuitable without further recourse. The CQA Officer may obtain samples from other rolls in the batch. On the basis of testing these samples, the CQA Officer may choose to accept a portion of the batch while rejecting the remainder.
- ❑ If retesting does not result in passing test results as defined in the preceding paragraph, or if there is any other nonconformity with the material specifications, then the Installer shall withdraw the rolls from use in the project at the Installer's sole risk, cost, and expense. The Installer shall be responsible at its sole risk, cost, and expense for removing this geomembrane from the site and replacing it with acceptable geomembrane.

11.2.2 Earthwork

The Construction Contractor will be responsible for preparing the supporting soil according to the CQA Plans and specifications. The Construction Contractor will remove any stones greater than 2-inch diameter from the uppermost 6 inches of recompacted low-permeability soil liner below the geomembrane. Abrupt changes will be removed in grade, including ridges one inch or more left from smooth drum rolling and cracking greater than 0.5-inches in either width or depth. For installation of any of the geomembranes, the Installer will certify in writing that the surface on which the geomembrane will be installed is acceptable. This certification of acceptance will be reported daily by the Installer prior to the start of geomembrane installation in the area under consideration. Unacceptable areas noted by the Installer will be immediately reported to the COIA.

The soil surface will also be examined daily by the COIA to ensure the surface on which the geomembrane will be installed, does not contain undesirable objects and to evaluate any areas softened by precipitation or cracked due to desiccation. The daily observation will be documented in the daily report. Areas determined to be unacceptable will be reworked until acceptable.

11.2.3 Placement

<u>Location and Layout Drawing</u>

A layout drawing for the geomembrane installation covered by this CQA Plan will be prepared by the Installer prior to installation and submitted to the CQA Officer, showing the location of geomembrane panels to be installed and anchorages to be installed. Panel layout drawings are not required for repairs.

<u>Installation Techniques</u>

Geomembrane panels will be installed using one of the techniques described below. The Installer will determine the method that best suits the conditions at the time of installation considering factors such as schedule and weather conditions.

- ❑ All geomembrane panels are placed prior to field seaming, in order to protect the underlying soil from rain, etc. Seams may be tack-welded or sand-bagged to prevent the geomembrane panels from shifting and to maintain proper overlap for eventual seaming.
- ❑ Geomembrane rolls are placed one at a time, and each panel is seamed immediately after placement.
- ❑ Any combination of the above two techniques.

If a decision is reached to place all panels prior to field seaming, care should be taken to facilitate drainage in the event of precipitation. Scheduling decisions must be made during placement in accordance with varying conditions. The COIA will evaluate every change in the schedule proposed by the Installer and will advise the CQA Officer on the acceptability of that change. The COIA will document that the condition of the supporting soil has not changed detrimentally during installation.

The COIA will record the roll number, location, and date of each geomembrane panel installed to document that the placement plan is followed. In addition, the COIA will document the following:

- ❑ Equipment used does not damage the geomembrane by handling, excessive heat, leakage of hydrocarbons, or by other means.
- ❑ Personnel working on the geomembrane do not smoke, wear damaging clothing, or engage in other activities that could damage the geomembrane.
- ❑ Method used to unroll the geomembrane does not cause scratches or crimps in the geomembrane and does not damage the supporting soil.
- ❑ Method used to place the rolls minimizes wrinkles and slack.
- ❑ Adequate temporary loading or anchoring (continuously placed, if necessary), which will not damage the geomembrane, will be placed to prevent uplift by the wind.
- ❑ Direct contact with the geomembrane will be minimized. The geomembrane will be protected by geotextiles, extra geomembrane, or other suitable materials, in areas where excessive traffic may be expected. No direct contact with the geomembrane by heavy equipment, automobiles, or all-terrain vehicles will be allowed.
- ❑ Method used to construct and backfill the anchor trench to prevent damage to the geomembrane.
- ❑ Ensure rub sheets are removed to the extent possible following liner installation.
- ❑ Confirm that the in-place geomembrane is adequately ballasted to prevent displacement.
- ❑ Observe anchor trench backfilling and compaction as specified.
- ❑ The geomembrane anchor trenches shall be constructed to the lines, grades, and minimum dimensions shown on the drawings and shall be free of loose or disturbed material, debris, and standing water upon geomembrane placement.
- ❑ Stones greater than 2 inches in diameter placed within 6 inches of the geomembrane liner will be removed.

The COIA will inform the CQA Officer and document if any of the above conditions are not fulfilled.

<u>Weather Conditions</u>

Geomembrane placement will not be performed in an area of ponded water, during precipitation events, in the presence of excessive winds, or if the ambient air temperature is less than 32°F or above 104°F (unless demonstrated by the Installer and approved by the CQA Officer). The COIA will document that this condition is fulfilled. The CQA Officer will cause to cease or postpone the geomembrane placement when conditions are unacceptable. With the approval of the CQA Officer, geomembrane placement may be performed in adverse weather conditions if all necessary steps are taken to provide an acceptable environment for geomembrane placement and welding.

Damages

The COIA will examine each panel for damage after placement and determine which panels, or panel portions, should be rejected, repaired, or accepted. Damaged panels or panel portions that have been rejected will be marked, and their removal from the site will be recorded by the COIA. Panel repairs will be made according to the procedures described below.

11.3 Defects and Repairs

This section applies to all defects and repairs resulting from examinations, tests, or visual observations performed on the geomembrane material itself and on the seams used in joining rolls in the field.

11.3.1 Identification

All seam and non-seam areas of the geomembranes will be examined and documented by the COIA for identification of defects, holes, blisters, undispersed raw materials, and any signs of contamination by any foreign matter. Because light reflected by the geomembrane helps to detect defects, the surface of the geomembrane will be clean at the time of examination. The geomembrane surface will be swept with a broom and/or washed by the Installer if the amount of dust or mud inhibits examination.

11.3.2 Evaluation

Each suspect area identified will be nondestructively tested using the vacuum box test method. Each location that fails the non-destructive tests will be marked (according to the marking procedures agreed upon during the preconstruction meeting) and repaired by the Installer.

11.3.3 Repair Procedures

Any portion of the geomembrane exhibiting a flaw or failing a destructive or nondestructive test will be repaired. Several procedures exist for the repair of these areas. The procedures available include the following:

- ❑ Patching—used to repair large holes, tears, undispersed raw materials, and contamination by foreign matter.
- ❑ Grinding and rewelding—used to repair small sections of extruded seams.
- ❑ Spot welding or seaming–used to repair small tears, pinholes, or other minor, localized flaws.
- ❑ Capping—used to repair large lengths of failed seams.
- ❑ Removal and replacement—used to replace nonconforming or damaged panels or portions thereof.
- ❑ Others may be used at the recommendation of the Installer if agreed upon by the CQA Officer and the COIA.

The repair procedures, materials, and techniques will be approved in advance of the specific repair by the CQA Officer, COIA, and Installer. At a minimum, the following provisions will be satisfied:

- Patches or caps will extend at least 6 inches beyond the edge of the defect, and all corners of patches will be rounded with a radius of at least 3 inches.
- Geomembrane surfaces must be clean and dry at the time of repair.

11.3.4 Examination of Repairs

Each repair will be numbered and logged according to the repair procedures agreed upon during the preconstruction meeting. Each repair will be nondestructively tested using a vacuum box for extrusion welds and air-pressure testing for fusion welds. Repairs that pass the above testing will be considered to be adequately repaired, except that large caps may be of sufficient extent to require destructive seam sampling and testing, at the discretion of the COIA.
Failed tests indicate that the repair was inadequate and will be redone and retested until a passing result is obtained. The COIA will document that repairs have been subjected to nondestructive testing and will record the number of each repair, the date, and the test outcome.

11.3.5 Large Wrinkles

When seaming of the geomembrane is completed, the COIA will examine the geomembrane for wrinkles and determine which wrinkles should be cut and repaired by the Installer. Each repair will be numbered, logged and nondestructively tested to the procedures agreed upon during the preconstruction meeting.

11.4 Field Seaming

This section covers the quality assurance procedures on seams used to join the rolls of geomembrane into a continuous layer. The installation of each of the geomembranes at the landfill facility will include 100 percent nondestructive testing of all field seams to determine openings or gaps along the seams. In addition, destructive testing will be performed at a routine interval for determining the strength and mode of failure of field seams in both the shear and peel modes.

The allowable field seam methods, equipment, personnel qualifications, and destructive and nondestructive testing methods are described in this section.

11.4.1 Seam Layout

The Installer will provide the CQA Officer and the COIA with seam layout drawings for each geomembrane installation covered by this CQA Plan showing each expected seam. The CQA Officer will review the seam layout drawing and document that it is consistent with the accepted practice and the design plans and specifications. Any variations of consequence, such as a change in overall seam direction, shall be reviewed by the CQA Officer before proceeding with seaming of said variations of consequence.

In general, horizontal seams will not be allowed on slopes steeper than 10 percent. However, at the discretion of the CQA Officer this practice may be modified. In corners and at other odd-shaped geometric intersections, the number of seams should be minimized. A seam numbering system comparable and compatible with the geomembrane roll numbering system will be agreed upon at the Preconstruction Meeting.

11.4.2 Seaming Equipment

The approved process for production field seaming (roll to roll) are the dual track fusion- type welding seam method and the extrusion welding process. Specialty seams and repair seams (non-production) will be done by the extrusion welding process. No other processes can be used without prior written authorization from the CQA Officer and the COIA. Dual-track welding should be used on panel-to-panel seams whenever possible.

Dual Track Fusion Welding Process

The Installer will meet the following requirements regarding the use, availability, and cleaning of the equipment to be used at the job-site:

- ❑ An automated self-propelled type of apparatus will be used.
- ❑ The welding apparatus will be equipped to continuously monitor applicable temperatures.
- ❑ One spare operable seaming device will be maintained on site at all times.
- ❑ Equipment used for seaming should not damage the geomembrane.
- ❑ The geomembrane should be protected in areas of heavy traffic to prevent damage.
- ❑ For cross seams, the edge of the cross seams will be ground to a smooth incline (top and bottom) prior to welding.
- ❑ For seam intersections the intersecting dual track seams shall be patched.
- ❑ The electric generator for the equipment will be placed on a smooth base in such a way that no damage occurs to the geomembrane. Similarly, a smooth insulating plate or fabric will be placed beneath the hot equipment after usage.
- ❑ A small movable piece of geomembrane may be used directly below each geomembrane overlap that is to be seamed to prevent buildup of water and/or moisture between the geomembrane sheets. The geomembrane piece is slid along the overlap as the seaming progresses. This piece is removed when the seam is completed.

The COIA will perform the following tasks relative to the use of dual hot wedge seaming devices:

- ❑ Log apparatus, ambient air, and geomembrane surface temperatures, and apparatus-operating temperatures and speed at appropriate intervals.
- ❑ Document that the Installer maintains on site the number of spare operable seaming devices agreed upon at the Pre-Construction meeting.
- ❑ Document that equipment used for seaming is not likely to damage the geomembrane.
- ❑ Document that for cross seams, the intersecting dual hot wedge seam is patched using the extrusion fillet process described below.
- ❑ Document that the electric generator is placed on a smooth base such that no damage occurs to the geomembrane.

- ❑ Document that a smooth insulating plate or fabric is placed beneath the hot equipment after usage.
- ❑ Document if a small movable geomembrane layer is used directly below each geomembrane overlap that is to be seamed to prevent buildup of water and/or moisture between the geomembrane sheets.

<u>Extrusion Welding Process</u>

The Installer will meet the following requirements regarding the use, availability, and cleaning of extrusion welding equipment to be used at the job-site:

- ❑ The welding apparatus will be equipped to continuously monitor temperature at the nozzle.
- ❑ One spare operable seaming device will be maintained on site at all times.
- ❑ Equipment used for seaming should not damage the geomembrane.
- ❑ The geomembrane should be protected in areas of heavy traffic to prevent damage.
- ❑ The extruder will be cleaned and purged prior to beginning seaming, and at any time that seaming operations are stopped, until all heat-degraded extrudate has been removed from the barrel.
- ❑ The electric generator for the equipment will be placed on a smooth base in such a way that no damage occurs to the geomembrane. Similarly, a smooth insulating plate or fabric will be placed beneath the hot equipment after usage.
- ❑ Grinding geomembrane surfaces for welding preparation shall not be performed more than 1 hour prior to seaming.

The Installer and, if applicable, the Geomembrane Manufacturer will provide documentation to the CQA Officer regarding the quality of the extrudate used in the welding apparatus. At a minimum, the extrudate should be compatible with the geomembrane liner material and contain the same grade and quality of polyethylene resin as used in the base material.

The Installer and COIA will perform the following tasks relative to the use of extrusion welding devices:

- ❑ Log apparatus (machine number/ ID), extrudate, ambient air, and geomembrane surface temperatures at appropriate intervals.
- ❑ Document that the Installer maintains on site the number of spare operable seaming devices agreed upon at the Pre-Construction meeting.
- ❑ Document that equipment used for seaming is not likely to damage the geomembrane.
- ❑ Document that the extruder is purged prior to beginning a seam until all heat degraded extrudate has been removed from the barrel.
- ❑ Document that the electric generator is placed on a smooth base such that no damage occurs to the geomembrane.
- ❑ Document that grinding is completed no more than 1 hour prior to seaming.

- ❑ Document that a smooth insulating plate or fabric is placed beneath the hot equipment after usage.

11.4.3 Personnel Qualifications

All personnel performing seaming operations will be qualified by experience or by successfully passing seaming tests for the type of seaming equipment to be used. At least one seamer will have experience seaming a minimum of 2,000,000 ft^2 of polyethylene geomembrane using the same type of seaming apparatus to be used at the landfill facility. The most experienced seamer, the "master seamer," will have direct supervisory responsibility at the job-site over less experienced seamers. At least 90% of the seams shall be completed by seamers who have installed at least 100,000 ft^2 of geomembrane.

The Installer will provide a list of proposed seaming personnel and their experience records to the CQA Officer and the COIA for their review and approval.

11.4.4 Weather Conditions

The range of weather conditions under which geomembrane seaming can be performed are as follows:

- ❑ Unless otherwise authorized in writing by the CQA Officer, no seaming will be attempted or performed at an ambient temperature below 32°F or above 104°F.
- ❑ Geomembrane will be dry and protected from the wind.
- ❑ Seaming will not be performed during any precipitation event unless the Installer erects satisfactory shelter to protect the geomembrane areas for seaming from water and/or moisture.
- ❑ Seaming will not be performed in areas where ponded water has collected below the surface of the geomembrane.

If the Installer wishes to use methods that may allow seaming at ambient temperatures below 32°F or above 104°F, the Installer will demonstrate and certify that the methods and techniques used to perform the seaming produce seams that are entirely equivalent to seams produced at temperatures above 32°F and below 104°F, and that the overall quality of the geomembrane is not adversely affected.

The COIA will document the following items:

- ❑ Ambient temperature at which seaming is performed.
- ❑ Any precipitation events occurring at the site, including the time of such occurrences.

The COIA will inform the CQA Officer if any of the weather conditions are not being fulfilled. The CQA Officer will cause to cease or postpone the geomembrane seaming when weather conditions are unacceptable.

11.4.5 Overlapping and Temporary Bond

The Installer will be responsible for the following:

- ❑ Panels of geomembranes have a finished overlap of a minimum of 3 inches for extrusion welding and 4 inches for fusion welding; but, in any event, sufficient overlap will be provided to allow peel tests to be performed on the seam.

- ❑ No solvents or adhesives will be used on the geomembranes unless the product has been approved in writing by the CQA Officer. Approval can only be obtained by submitting samples and data sheets to the CQA Officer for testing and evaluation.
- ❑ Procedures used to temporarily bond adjacent geomembrane rolls does not damage the geomembrane; in particular, the temperature of the hot air at the nozzle of any spot welding apparatus is controlled such that the geomembrane is protected at all times against potential damage.

The COIA will log all appropriate data and information for the above requirements.

11.4.6 Trial Seams

Trial seams will be made on fragment pieces of geomembrane representative of actual material to be used to document that seaming conditions are adequate. Trial seams will be made at the beginning of each day of seaming period, and at least once every five hours thereafter, for each seaming apparatus used that day. Also, each seamer will make at least one trial seam each day. Trial seams will be made under the same conditions as actual seams. The trial seam samples will be at least 3 feet long by 1 foot wide after seaming, with the seam centered lengthwise. Seam overlap will be as indicated above under Overlapping and Temporary Bond.

The trial seams will be examined for squeeze-out, foot pressure applied by seaming equipment, and general appearance by the Installer. If the seam fails any of these examinations, it will be repeated until satisfactory seams are obtained.

The COIA will observe all trial seam procedures. A minimum of five specimens, each 1 inch wide, will be cut from opposite ends of the trial seam sample by the installer. The remainder of the sample shall be given to the COIA. The specimens will be subject to in field shear and peel tests conducted in accordance with the most recent edition of ASTM D6392. The weld visually must appear continuous and homogeneous and the test seam shall meet the current peel and shear strength criteria stipulated in the most current version of GRI-GM19a as noted in Tables 2 and 4 for HDPE and LLDPE, respectively.

If a specimen fails, a second trail seam shall be made, inspected, and tested. If the second test also fails, the seaming apparatus and seamer will not be accepted and will not be used for seaming until the deficiencies are corrected and two consecutive successful trial seams are achieved.

The remainder of the trial seam sample will be identified and marked by the COIA as follows:

- ❑ The sample will be assigned a number and marked as to welding apparatus used and seamer name.
- ❑ The date, time, applicable welding equipment operating temperatures, and ambient temperature at the time of seaming.
- ❑ Whether the sample passes or fails.

The COIA will observe all trial seam procedures. The COIA may randomly select trial field samples for destructive testing by the Geosynthetic Testing Laboratory. Testing frequency will be at the discretion of the COIA.

If a trial seam sample fails a destructive test performed by the Geosynthetic Testing Laboratory, according to the acceptance criteria, then a destructive test seam sample(s) will be taken from each of the seams completed by the seamer during the shift related to the failed trial seam test. These samples will be forwarded by the COIA to the Geosynthetic Testing Laboratory and, if any of them fails the tests, the procedures described in Destructive Seam Testing will apply. The conditions of this paragraph will be considered met if a destructive seam test sample, collected and tested according to the provisions under Destructive Seam Testing has already been taken and passed.

11.4.7 Seam Preparation

The Installer will meet the following conditions for each of the geomembrane installations covered by this CQA Plan:

- ❑ Prior to seaming, the seam area is clean and free of moisture, dust, dirt, debris of any kind, and foreign material.
- ❑ If seam overlap grinding is required, the grinding process will be completed according to the Geomembrane Manufacturer's instructions within 1 hour of the seaming operation, and in a way that will not damage the geomembrane or cause excessive striation of the geomembrane surface.
- ❑ Seams will be aligned so as to minimize the number of wrinkles and "fishmouths."

11.4.8 General Seaming Procedures

Unless otherwise specified, the general seaming procedures to be used by the Installer for each of the geomembrane installations covered by this CQA Plan, and observed by the COIA, will be as follows:

- ❑ As much as practical, field seaming shall start from the top of the slope down. Tack welds (if used) shall use heat only; no double sided tape, glue or other method will be permitted;
- ❑ The completed liner shall not exhibit any "bridging" or "trampolining" (i.e., lifting of geomembrane off the subgrade surface due to excessive tension on the geomembrane) at the time protective cover or other materials are being placed over the Geomembrane;
- ❑ Dual hot wedge fusion welding shall be used wherever possible;
- ❑ Fishmouths or wrinkles at the seam overlaps shall be "walked out" if possible or cut along the ridge of the wrinkle in order to achieve a flat overlap and the cut fishmouths or wrinkles seamed or patched;
- ❑ If seaming operations are to be conducted at night, adequate illumination shall be provided;
- ❑ Seaming shall be done under conditions which will eliminate overlap beads, beads on top of beads, and sharp creases on the bottom of seams;
- ❑ If an extrusion seam must be restarted, the end of the existing extrusion bead must be ground and the new seaming must start such that there is no less than a 2-inch overlap of the existing and new beads;

- ❑ Seaming shall extend to the outside edge of the geomembrane panels which shall be placed in the anchor trenches;
- ❑ Grinding shall be completed in accordance with Manufacturer recommendations; over-ground or improperly ground areas shall be replaced at no expense to Owner.

11.4.9 Nondestructive Testing

Each field seam will be nondestructively tested over its full length using one of the methods described in this section. The purpose of nondestructive testing is to determine the continuity of the seams. Nondestructive testing, at this stage of development, does not provide any information on the strength of seams. Seam strengths will be determined by destructive testing methods. Failure of any of the nondestructive or destructive tests will require the repair of the failed section.

Nondestructive testing as described in this section will be performed on seams for every geomembrane installation covered by this CQA Plan. The recommended test methods for conducting the nondestructive seam testing are the air pressure test for fusion welds and the vacuum box test for extrusion welds. These two nondestructive testing methods are described below.

The COIA will perform the following:

- ❑ Observe all nondestructive seam testing, and examine all seams for squeeze-out, foot pressure, and general appearance. Failure of these criteria will be considered as failure of the seam, and repair or reconstruction will be required.
- ❑ Document location, date, test unit number, name of tester, and outcome of all testing.
- ❑ Inform the Installer and CQA Officer of any required repairs.
- ❑ Confirm that appropriate repairs are made and that the repairs are retested nondestructively with passing results.

<u>Air Pressure Testing</u>

The following test procedures are applicable only to dual hot wedge fusion seams. The equipment for performing the test should meet the following minimum requirements:

- ❑ An air compressor or hand pump equipped with a pressure gauge and regulator capable of producing and sustaining a pressure of 50 psi and mounted on a cushion to protect the geomembrane surface.
- ❑ Fittings, rubber hose, valves, etc., to operate the equipment, and a sharp hollow needle or other approved pressure feed device.
- ❑ Air pressure monitoring device capable of indicating 150% of the minimum allowable testing pressure.

Air pressure testing will be performed according to the following procedure:

- ❑ Seal both ends of the seam to be tested.
- ❑ Insert needle or other approved pressure feed device into the air space at one end of the fusion welded seam.

- ❑ Energize the air compressor or hand pump and pressurize the air channel to a pressure of 25-30 psi. Close the valve and observe the pressure response in the seam air space. The pressure should soon stabilize, and then remain constant and without fluctuations.
- ❑ Record the initial test pressure in the seam. The results below must be met:

Geomembrane Thickness (mils)	Minimum Test Pressure (psi)	Maximum Test Pressure (psi)
40	25	30
60	25	30

- ❑ If pressure loss exceeds Maximum Permissible Pressure Differential or does not stabilize, locate faulty area, repair and retest seam.

  Maximum Permissible Pressure Differential

Geomembrane Thickness (mils)	Pressure Difference (psi)	Time Period (minutes)
40	4	2
60	3	5

- ❑ If pressure loss does not exceed the Maximum Permissible Pressure Differential over the time period outlined in the table above, then the seam is considered to have passed the nondestructive test.
- ❑ The Installer must verify that the air channel tested was not obstructed by noting a release of pressure at the end of the tested seam interval opposite the pressure gauge.

For any seam interval which fails the air pressure nondestructive test, additional nondestructive testing or visual inspection shall be used to identify, if possible, the faulty area of the seam. The faulty area shall be repaired and retested. If the faulty area cannot be identified, then the entire seam shall be repaired and retested.

Vacuum Box Test

Vacuum box testing is to be used on those seams made by the extrusion fillet process, to locate precisely the defects identified from air pressure testing, or to evaluate suspect seam and non-seam areas. Vacuum box testing shall be completed in accordance with ASTM D5641.

Vacuum box testing equipment must meet the following minimum standards:

- ❑ A five-sided vacuum box with an open bottom, a clear viewing panel on top, and a pliable gasket attached to the bottom.
- ❑ A vacuum assembly equipped with a pressure controller and pipe connections capable of achieving a vacuum of 10 psig.
- ❑ A vacuum gauge on the tank with a minimum operating range of 0 to 10 psig and a vacuum gauge on the vacuum box with a minimum operating range from 0 to 10 psig.

The following procedure will be used in performing the vacuum box test:

- ❑ Step 1: Seams to be tested should be clean and relatively free from soil or foreign objects that might prohibit a good seal from being formed between the vacuum chamber and the geomembrane.
- ❑ Step 2: Energize the vacuum pump and reduce the tank pressure to approximately 24 inches of water vacuum (or approximately 3 psig).
- ❑ Step 3: Wet a strip of geomembrane approximately twice the size of the vacuum box with the soapy solution.
- ❑ Step 4: Place and center the vacuum box with the gasket in contact with the geomembrane surface over the wetted area of the seam.
- ❑ Step 5: Applying a normal force to the top of the vacuum box, close the bleed valve and open the vacuum valve. Check to make certain that a tight seal is created between the geomembrane and the vacuum box. A minimum vacuum of 5 inches of water should be used for testing with the maximum allowable testing pressure never exceeding 10 inches of water vacuum.
- ❑ Step 6: With the vacuum drawn, use the viewing panel to examine the geomembrane seam for bubbles resulting from the flow of air through the seam. Continue this examination for not less than 10 seconds.
- ❑ Step 7: Remove the vacuum box by first closing the vacuum valve and opening the bleed valve. Proceed to Step 8 if bubbles appear in Step 6. If no bubbles appear in Step 6, then proceed directly to Step 9.
- ❑ Step 8: If bubbles appear through the geomembrane, the defective area should then be marked for repair. All repairs must be nondestructively tested with passing results.
- ❑ Step 9: Move the vacuum box along the seam to be tested, overlapping the previously tested area by no less than three inches.

11.4.10 Destructive Seam Testing

Destructive seam testing will be performed on the geomembrane seams covered by this CQA Plan. Destructive seam testing is performed to determine the strength of the seam in both shear and peel failure modes. Destructive seam testing should be performed within 48 hours of sampling either in an on-site laboratory by personnel under the direction of the CQA Officer or at the Geosynthetic Testing Laboratory. Samples will not be taken near high tensile stress areas.

<u>Location and Sampling Frequency</u>

The COIA will select locations where seam samples will be cut out for the destructive testing. Test locations will be determined during seaming at the COIA's discretion. Selection of such locations may be prompted by suspicion of excess crystallinity, contamination, offset welds, or any other potential causes of an imperfect seam. The Installer will not be informed in advance of any location where seam samples will be taken.

The minimum frequency of sample collection will be one test location per every 500 lineal feet of seam length per welder-seamer, per day unless otherwise approved by IEPA.

Sampling Procedure

Samples will be cut under the direction of the COIA as the seaming progresses. For each sample location, the following information will be documented:

- ❑ Assign a sample number and mark accordingly.
- ❑ Record sample location on layout drawing.
- ❑ By sample number, record the reason for collecting the sample (e.g., as part of statistical testing program, suspicious seam, etc.).
- ❑ Note on the sample, for the peel test, which geomembrane is the top and which is the bottom with respect to seams performed using dual hot wedge or fusion weld techniques.
- ❑ Record pertinent information including date, time, seaming unit number, seam number, and the name of the seamer.

Specimens for qualitative field and quantitative testing will be taken prior to removal of the laboratory sample. Samples for field tensiometer testing will be 1 inch wide by 12 inches long with the seam centered parallel to the width. The distance between the two samples should be 42 inches measured from inside edge to inside edge. If both samples pass the field tensiometer test described below under Field Test Methods, then the sample for laboratory testing will be taken according to the procedure described below.

The sample for laboratory testing will be located between the two samples used for field testing. Therefore, the laboratory sample will be 12 inches wide by 42 inches long with the seam centered lengthwise. The sample will be cut by the COIA into three parts and distributed as follows:

- ❑ A 12-inch-by-14-inch sample will be given to the Installer for testing if so desired.
- ❑ A 12-inch-by-14-inch sample will be given to the Owner for record storage.
- ❑ A 12-inch-by-14-inch sample will be transmitted to the Geosynthetic Testing Laboratory or on-site testing laboratory by the COIA.

The COIA will make periodic reports to the Installer detailing the locations of samples taken that must be repaired.

All holes cut into the geomembrane resulting from destructive seam sampling will be immediately repaired by the Installer in accordance with the repair procedures described in this Section. The repaired area will be nondestructively tested in accordance with the requirements of this Section.

Field Test Methods

The two 1-inch-wide samples for field tensiometer testing described above under Sampling Procedure will be qualitatively tested for both peel and shear. Quantitative test results shall be recorded and evaluated against the acceptance specifications listed in Tables 2 and 4 in Section 20. The seam will be considered as passing if the failure in both peel and shear does not occur within the seam. If the samples fail the field tensiometer test, then the seam reconstruction procedures for the repair of the defective seam must be implemented.

Laboratory Test Methods

Laboratory testing of the destructive seam samples will be performed by the Geosynthetic Testing Laboratory or on-site testing laboratory under the direction of the CQA Officer. All laboratory destructive seam tests, whether performed on trial seam samples or on samples cut out from production seams, will be performed in general accordance with the methodology of GRI-GM19a and ASTM D4437, which stipulates that at least five specimens should be tested in shear and five in peel. Samples will be cut in alternating order and should also be tested in the order of cutting, to determine if any trend in seam quality along the length of the sample exists. All specimens will be cut as 1-inch-wide strips.

The following tests will be performed on each seam sample submitted for laboratory testing:

- **Shear and peel maximum tension** is the maximum load per unit width of a 1-inch-wide specimen expressed in pounds per inch of width in both the shear and peel mode, according to ASTM D4437 as modified by GM-19a.
- **Shear elongation at break** is the extension at break expressed as a percentage of the initial distance between the edge of the fused track and the nearer grip. This distance should be the same on both sides of the seam and is usually 2 inches. No referenced ASTM test exists for this procedure as defined; however, the specimen will be elongated to a maximum of 100 percent with any failures of individual specimens noted. For specimens that fail below 100 percent elongation, the value that failure occurred at will be noted on the results.
- **Peel seam separation** estimates the area of seam interface separation expressed as a percentage of the original area.

Also, for both the seam shear and peel tension tests, an indication will be given for each specimen tested that defines the locus of the failure. The loci will be defined in accordance with GM-19a.

For seam shear tests, specimens should be inserted in the test machine with gauge lengths of 1 inch between each edge of the seam and the adjacent grip. The crosshead speed will be 2 inches per minute.

Parameters monitored during the test will be load and crosshead displacement. The test may be terminated when the crosshead has moved 2 inches.

For peel tests, specimens will be inserted in the tensile machine, so grips are no closer than 1 inch to the edge of the seam. The grips may be closer than 1 inch only if there is insufficient material to allow insertion at this setting. All seam peel specimens will be tested 2 inches per minute crosshead speed.

For shear tests, the following values will be reported for each specimen tested:

- Maximum tension in pounds per inch
- Elongation at break indicating at what percentage the specimen failed (up to a tested maximum of 100)

- The locus of failure using the above designations

For peel tests, the following values will be reported for each specimen tested:

- Maximum tension in pounds per inch
- Seam separation expressed as percent of original seam area
- Locus of failure

Role of Testing Laboratory

The Geosynthetic Testing Laboratory or on-site testing laboratory will be responsible for performing the tests on samples submitted to them as described above. Results of tests performed will be reported to the CQA Officer and the COIA. Retesting of seams, because of failure to meet any or all of the specifications listed below can only be authorized by the CQA Officer.

The Geomembrane Manufacturer and/or Installer may perform their own quality control testing in accordance with the methods and procedures defined above under Laboratory Test Methods; however, the results, if substantially different from those obtained by the Geosynthetic Testing Laboratory or on-site laboratory, may only be used to request a retesting by the Geosynthetic Testing Laboratory or on-site testing laboratory. All quality assurance test results from the Geosynthetic Testing Laboratory or on-site laboratory govern over any test results from the Geomembrane Manufacturer of Installer. Only the CQA Officer is authorized to approve a retesting request.

Procedures for Determining Destructive Seam Test Failures

The procedures described in this section apply to the destructive testing procedures defined above under Field Test Methods and Laboratory Test Methods. Procedures for repairing failed seams are given in this Section of this CQA Plan.

Results from the shear and peel tests for the HDPE and LLDPE geomembranes will be evaluated against the criteria in Tables 2 and 4.

All tabular criteria for each respective geomembrane type must be met for a given seam to be considered acceptable.

The Installer has the following two options in determining the repair boundary whenever a seam has failed either the field tensiometer testing or laboratory destructive testing:

- The seam can be reconstructed between any two previously tested and passed destructive seam test locations.
- The Installer can trace the welding path to an intermediate location (at a 10-foot minimum from the point of the failed test in each direction) and request that field tensiometer tests be performed at these intermediate locations. If the field tensiometer sample results are acceptable, then full laboratory samples are taken and tested. If the laboratory tests are acceptable, then the seam is reconstructed between these intermediate locations. If either sample fails, then the process is repeated until acceptable destructive seam tests have been performed in both directions away from the original failed sample location. All retesting of seams, according to this procedure, will use the sampling methodology described above

under Sampling Procedure.

For seams reconstructed due to a failing destructive seam sample, that are greater than 150 feet in length, an additional sample taken from the reconstructed zone must pass destructive seam testing.

The COIA will be responsible for documenting all actions, including test results submitted by the Geosynthetic Testing Laboratory, taken in conjunction with seam testing. The COIA will also be responsible for keeping the CQA Officer informed on seam testing results and seaming progress.

11.5 Post-Construction

Each geomembrane covered by this CQA Plan will be examined by the COIA. Any defects, whether due to failed seams, pinholes, or other penetrations, will be repaired. Deployment of the geotextile cushion and placement of the drainage layer material shall proceed as soon as practical following the COIAs testing and acceptance of completed geomembrane areas.

For pipe penetrations and appurtenances, the Installer and COIA shall verify that the following requirements are met:

- ❑ Seaming performed on and pipe penetrations, and other appurtenances will be non-destructively tested according to one of the following methods: (1) vacuum box method; (2) spark testing according to Manufacturer's recommended procedures; (3) factory testing, along with certification, of prefabricated seams (i.e., pipe boots).
- ❑ The geomembrane has not been visibly damaged while making connection to sumps and appurtenances; and
- ❑ Installation of the geomembrane in the area of the pipe penetrations and connections of the geomembrane to these structures and appurtenances have been made according to the approved engineering plans and shop drawings.

For soils placed above the geomembrane (or geotextile), the COIA shall document that the following general criteria is met:

- ❑ Do not place soils on the geomembrane at an ambient temperature below 32°F, nor above 104°F, unless otherwise specified.
- ❑ Do not drive equipment used for placing the soil directly on the geomembrane.
- ❑ A minimum thickness of 1 foot of soil is specified between a low ground pressure dozer (maximum contact pressure of 5 psi) and the geomembrane.
- ❑ A minimum thickness of 2 feet of soil is specified between tracked equipment (contact pressures exceeding 5 psi) and the geomembrane.
- ❑ A minimum thickness of 3 feet of soil is specified between rubber-tired vehicles and the geomembrane, including areas of heavy traffic.
- ❑ The geomembrane (geotextile) shall be covered within 30 days of completing geomembrane quality control and quality assurance testing.

11.6 Leak Location Survey

A leak location survey may be performed after completion of installation of geomembrane liner and/or drainage layer blanket, in accordance with ASTM D7007, Standard Practices for Electrical Methods for Locating Leaks in Geomembranes Covered with Water or Earth Materials, or an equivalent method approved by the CQA Officer and Owner.

12.0 GEOTEXTILES

This section of the CQA Plan applies to non-woven geotextiles used in the final cover and leachate extraction system as cushion and filter geotextiles. A 12-ounce geotextile cushion will be placed over the geomembrane liner prior to placement of the leachate drainage layer material in the Site 2 North Expansion. An 8-ounce geotextile filter will be placed on top of the leachate drainage layer in the Site 2 North Expansion. And a 6-oz/yd^2 geotextile layer will be placed on top of the coarse aggregate bedding of the underdrain collection pipe system.

This section is divided into three major subheadings, which cover the quality assurance requirements for Pre-Installation (includes Geotextile Manufacturers), Installation, and Post-Installation (includes the final examination of the geotextiles prior to placing the appropriate material above the geotextile). The terms Pre-Installation, Installation, and Post-Installation are applicable only to the geotextile installation and do not apply to the overall construction of the landfill facility.

12.1 Pre-Installation

12.1.1 Manufacturing

<u>Material Specifications</u>

The following list specifies the required geotextile materials for construction of the Site 2 North Expansion:

Composite liner

Above coarse aggregate bedding of the underdrain collection pipe system	6 oz/yd^2
Above granular drainage layer/coarse aggregate on composite liner and sideslopes	8 oz/yd^2
Below granular drainage layer/coarse aggregate on composite liner and sideslopes	12 oz/yd^2

The Geotextile Manufacturer shall provide the Project Manager and the CQA Officer with a list of guaranteed properties for the type of geotextile to be supplied. The Geotextile Manufacturer shall provide the Project Manager and the CQA Officer with a written certification signed by a responsible party that the geotextile actually delivered has properties that meet or exceed the guaranteed properties. Material property values are provided in Tables 5, 6, 7, and 8.

<u>Quality Control Requirements</u>

Every roll of geotextile for delivery to the site must be manufactured and inspected by the Geotextile Manufacturer, according to the following requirements:

- ❑ The geotextile must contain no needles used for punching.
- ❑ The geotextile must be free of holes and any other sign of contamination by foreign matter.

12.1.2 Delivery, Handling, and Storage of Geotextile Rolls

Each geotextile roll, for use at the landfill facility, will be marked by the Geotextile Manufacturer with the following information and in the following manner:

- ❑ When fabric is rolled on a core, identify each roll with a durable gummed label, or an equivalent, on the inside of the core and on the outside of the protective wrapping for the roll.
- ❑ Each roll label will contain the following information at a minimum:
    - Name of manufacturer (or supplier)
    - Style and type number
    - Unit weight (ounces per square yard)
    - Roll length and width
    - Batch (or lot) number
    - Nominal product thickness
    - Date of manufacture
    - Direction for unrolling
    - Roll number

The Geotextile Manufacturer will use the following guidelines in packaging, wrapping, and preparing all geotextile rolls for shipment:

- ❑ When cores are required, use those that have a crushing strength sufficient to avoid collapse or other damage while in use.
- ❑ Cover each roll with a wrapping material that will protect the geotextile from damage due to shipment, water, sunlight, or contaminants.

The following practices should be used as a minimum in receiving and storing geotextile rolls in the designated storage area at the job-site:

- ❑ While unloading or transferring the geotextile rolls from one location to another, prevent damage to the wrapping or to the geotextile itself. If practicable, use fork lift trucks fitted with poles that can be inserted into the cores of rolls. Be sure that the poles are at least two-thirds the length of the rolls to avoid breaking the cores and possibly damaging the geotextile. Do not drag rolls.
- ❑ Store the geotextile rolls to ensure that they are adequately protected from the following:
    - Precipitation
    - Ultraviolet radiation, including sunlight
    - Strong oxidizing chemicals, acids or bases
    - Flames, including welding sparks
    - Temperatures in excess of 160°F
    - Soiling

The COIA will be responsible throughout the pre-installation, installation, and post-installation periods for observing and documenting that the Installer provides adequate handling equipment used for moving geotextile rolls and the equipment and that the handling methods used do not pose any risk of damage.

The COIA will be responsible for making certain that the Manufacturer, type, and thickness of each roll are correct. The COIA will also maintain a log of geotextile roll deliveries. The following information, at a minimum, will be recorded on the log for each shipment received at the job-site:

- Date of shipment from Geotextile Manufacturer
- Date of receipt of delivery at job-site
- For each geotextile roll the following information will be noted:
  - Roll number
  - Batch lot number

12.2 Installation

This section describes the quality assurance requirements applicable to the installation of non-woven geotextiles.

12.2.1 Placement

The Installer will install all geotextiles in such a manner to ensure that they are not damaged in any way and in a manner that complies with the following:

- On sideslopes, the geotextiles will be securely anchored and then rolled down the slope, or each roll will be mounted on a spreader bar suspended from a loader, lift, or similar heavy equipment and the geotextile will be unrolled by pulling down the slope. Geotextile panels will be deployed in such a manner as to continually keep the geotextile in tension.
- In the presence of winds, all geotextiles will be secured by other suitable methods. The temporary weighted material will be left in place until replaced with cover material as shown on the design plans and specifications.
- In-place geotextiles will be cut with special care to protect other materials from damage that could be caused by the cutting of the geotextiles.
- The Installer will take necessary precautions to prevent damage to any underlying layers during placement of the geotextile.
- During placement of geotextiles, care will be taken not to entrap in the geotextile any stones, excessive dust, or moisture that could damage the geotextile, or generate clogging of drains or filters.
- A visual examination of the geotextile will be carried out over the entire surface after installation by the Installer to ensure that no potentially harmful foreign objects, such as needles, are present.

The COIA will observe and document that each of the above steps are performed by the Installer. Any noncompliance with the above requirements will be reported by the COIA to the CQA Officer.

12.2.2 Seams and Overlaps

The following requirements will be met with regard to seaming and overlapping of geotextile rolls:

- Geotextile seams will be joined by overlapping, continuously sewing, wedge welding, or other methods approved by CQA Officer. Geotextiles will be overlapped by 6 inches. Seaming and stitching, if performed, will be done in the middle of the overlap.
- The Installer will pay particular attention to seams to ensure that no deleterious earthen materials could be inadvertently trapped beneath the geotextile.
- Sewing will be performed with thread made from the same base material as the geotextile, or suitable equivalent

The COIA will be responsible for observing and documenting that the above provisions are performed by the Installer in an acceptable manner. Any noncompliance with the above requirements will be reported by the COIA to the CQA Officer.

Any holes or tears in the geotextile can be repaired as follows:

- A patch from the same geotextile will be sewn or heat bonded in place with a 12- inch minimum overlap in all directions.
- Care will be taken to remove any soil or other material that may have penetrated the torn geotextile.
- The COIA will observe and document that the repair of any geotextiles is performed according to the above procedure.

12.3 Post-Installation

12.3.1 Final Examination

The COIA will perform a final geotextile examination after installation of each geotextile layer has been completed. The objectives of the final examination are as follows:

- Examine for presence of holes, tears, or other deterioration.
- Examine geotextile for excessive tension due to stretching of the fabric during installation.

If there will be an extended time delay between completion of the geotextile and the start of the installation of any overlying cover, then the Installer will make provisions, by temporarily covering or using other suitable methods, to protect the geotextile against exposure to sunlight and ultraviolet radiation.

12.3.2 Placement of Soil Materials

The Construction Contractor will place all soil materials located on top of a geotextile in such a manner as to minimize the following:

- Damage of the geotextile.
- Slippage of the geotextile on underlying layers.

- ❑ Excessive tensile stresses imposed on the geotextile.

The COIA shall document that the following general criteria is met:

- ❑ Do not place soil on the geotextile at an ambient temperature below 32°F nor above 104°F, unless otherwise specified.
- ❑ Do not drive equipment used for placing the soil directly on the geotextile.

13.0 GEOSYNTHETIC CLAY LINER

Geosynthetic Clay Liner (GCL) shall be installed in the leachate collection sumps, placed in between the low-permeability soil liner and Geomembrane liner. A summary of the required physical properties of the GCL can be found in the attached Table 11 (Geosynthetic Clay Liner Properties).

This section is divided into three major subheadings which cover the quality assurance requirements for Pre-Installation (includes GCL Manufacturers), Installation, and Post-Installation (includes the final examination of the GCL prior to placing the appropriate material above it). The terms Pre-Installation, Installation, and Post-Installation are applicable only to the geonet installation and do not apply to the overall construction of the landfill facility.

13.1 Pre-Installation

13.1.1 Manufacturing

The GCL Manufacturer shall provide the Project Manager and the CQA Officer with a list of guaranteed properties for the type of GCL to be supplied. The GCL Manufacturer shall provide the Project Manager and the CQA Officer with a written certification signed by a responsible party that the GCL actually delivered has properties that meet or exceed the guaranteed properties. Material property values are provided in Table 11.

13.1.2 Delivery, Handling, and Storage of GCL Rolls

Each GCL roll for use at the landfill facility will be marked by the GCL Manufacturer with the following information and in the following manner:

- ❑ Identify each roll with a durable gummed label, or an equivalent, on the inside of the core and on the outside of the protective wrapping for the roll.
- ❑ Each roll label will contain the following information at a minimum:
    - Name of manufacturer (or supplier)
    - Style and type number
    - Roll length and width
    - Batch lot number
- ❑ Date of manufacture
- ❑ Direction for unrolling
- ❑ Roll number

The GCL Manufacturer will use the following guidelines in packaging and preparing all geonet rolls for shipment:

- ❑ When cores are required, use those that have a crushing strength sufficient to avoid collapse or other damage while in use.

The following practices should be used as a minimum in receiving and storing GCL rolls in the covered storage area at the job-site:

- ❑ While unloading or transferring the GCL rolls from one location to another, prevent damage to the GCL. If practicable, use fork lift trucks fitted with poles that can be inserted into the cores of rolls. Be sure that the poles are at least two- thirds the length of the rolls to avoid breaking the cores and possibly damaging the GCL. Do not drag the rolls.

- ❑ Store the GCL rolls to ensure that they are adequately covered to protect from the following:
  - Precipitation
  - Ultraviolet radiation, including sunlight
  - Strong oxidizing chemicals, acids or bases
  - Flames, including welding sparks
  - Temperatures in excess of 160°F
  - Soiling

The COIA will be responsible throughout the pre-installation, installation, and post-installation periods, for observing and documenting that the Installer provides adequate handling equipment used for moving geonet rolls and that the equipment and handling methods used do not pose any risk of damage.

13.2 Installation

This section describes the quality assurance requirements applicable to the installation of GCL rolls.

- ❑ Ensure subgrade has been smooth rolled and free of debris, wheel ruts, sticks, rocks, or roots larger than 1 inch,
- ❑ Disapprove GCL deployment during inclement weather such as heavy rain, wind, snow, etc. unless specifically approved by the CQA Officer,
- ❑ Observe the GCL for defects prior to, during and after placement,
- ❑ Verify that the panels are placed as shown on the approved drawing, or as otherwise approved by the CQA Officer,
- ❑ Confirm that adjoining panels are overlapped, shingled, and loose granular bentonite has been applied in between.
- ❑ Confirm rub sheets are utilized for textured liner components installed above GCL,
- ❑ Observe the Contractor’s methods of placing and constructing the GCL into the leachate sumps, along with the overlying liner components to confirm that such methods do not damage the GCL, and
- ❑ Confirm that the in-place GCL is adequately ballasted to prevent displacement.

13.3 Post-Installation

The COIA will perform a final GCL examination after installation has been completed. The objectives of this step are as follows:

- ❑ Examine for presence of tears or defects.
- ❑ Examine overlaps and observe for excessive slack or wrinkles.

If any portion of the GCL requires repairs or replacements due to the above examination, they will be performed. The COIA will document the result of the final examination, including any subsequent repairs or replacements.

14.0 GEOCOMPOSITE

This section of the CQA Plan applies to geocomposites installed within the final cover drainage layer slopes and as required on floor subgrade and sideslope excavations. The double-sided geocomposite liner shall consist of non-woven 6-oz/yd^2 geotextile fabric heat bonded to the top and bottom of a geonet.

This section is divided into three major subheadings, which cover the quality assurance requirements for Pre-Installation, Installation, and Post-Installation. The terms Pre-Installation, Installation, and Post-Installation are applicable only to the geocomposite installation and do not apply to the overall construction.

14.1 Pre-Installation

The Geocomposite Manufacturer will provide the project manager and the CQA Officer with a list of guaranteed properties for the type of geocomposite to be supplied, per Tables 6 and 9 in Section 20 of this Plan. The Geocomposite Manufacturer will provide the project manager and the CQA Officer with a written certification signed by a responsible party that the geocomposites actually delivered have properties that meet or exceed the guaranteed properties. Material property values are provided in Table 10.

14.1.1 Interface Shear Testing

Additionally, the Operator will coordinate with the Geocomposite Manufacturer to submit a representative sample of the geocomposite to the qualified laboratory independent of the Geocomposite Drainage Layer Manufacturer for shear testing. Interface shear testing shall be once per construction season installation (or change in the manufacturer, materials, or manufacturing process) of the 4H:1Vor greater final cover slopes, but no more frequently than once during any 18 month period for the following interfaces, as applicable:

- ❑ Geocomposite Drainage Layer vs. Protective Cover Soil
- ❑ Geocomposite Drainage Layer vs. 40-mil Textured LLDPE Geomembrane

The geocomposite interface shear testing shall not be required for repairs and/or installations totaling less than 1,000 square feet individually, and 10,000 square feet combined over a 12-month period.

14.1.2 Delivery, Handling, and Storage of Geocomposite Rolls

Each geocomposite roll, for use at the landfill facility, will be marked by the Geocomposite Manufacturer with the following information and in the following manner:

- ❑ When fabric is rolled on a core, identify each roll with a durable gummed label, or an equivalent, on the inside of the core and on the outside of the protective wrapping for the roll.
- ❑ Each roll label will contain the following information at a minimum:
    - Name of manufacturer (or fabricator)
    - Style and type number
    - Roll length and width
    - Batch lot number, if applicable

- Date of manufacture
- Direction for unrolling
- Roll number

The Geocomposite Manufacturer will use the following guidelines in packaging, wrapping, and preparing all geocomposite rolls for shipment:

- ❑ When cores are required, use those that have a crushing strength sufficient to avoid collapse or other damage while in use.
- ❑ Cover each roll with a wrapping material that will protect the geotextile from damage due to shipment, water, sunlight, or contaminants.

The following practices should be used as a minimum in receiving and storing geocomposite rolls in the covered storage area at the job-site:

- ❑ While unloading or transferring the geocomposite rolls from one location to another, prevent damage to the geocomposite. If practicable, use fork lift trucks fitted with poles that can be inserted into the cores of rolls. Be sure that the poles are at least two-thirds the length of the rolls to avoid breaking the cores and possibly damaging the geocomposite. Do not drag the rolls.
- ❑ Store the geocomposite rolls to ensure that they are adequately covered to protect the geocomposite from the following:
  - Precipitation
  - Ultraviolet radiation, including sunlight
  - Strong oxidizing chemicals, acids or bases
  - Flames, including welding sparks
  - Temperatures in excess of 160°F
  - Soiling

The COIA will be responsible throughout the pre-installation, installation, and post-installation periods for observing and documenting that the Installer provides adequate handling equipment used for moving geocomposite rolls and that the equipment and handling methods used do not pose any risk of damage.

The COIA will maintain a log of geocomposite roll deliveries. The following information, at a minimum, will be recorded on the log for each shipment received at the job-site:

- ❑ Date of shipment from Geocomposite Manufacturer
- ❑ Date of receipt of delivery at job-site
- ❑ For each geocomposite roll, the following information will be noted:
  - Roll number
  - Batch lot number, if applicable

14.2 Installation

This section describes the quality assurance requirements applicable to the installation of geocomposites.

14.2.1 Placement

The Installer will install all geocomposites in such a manner as to ensure that they are not damaged in any way and in a manner that complies with the following:

- ❑ On sideslopes, the geocomposites will be securely anchored and then rolled down the slope, or each roll will be mounted on a spreader bar suspended from a loader, lift, or similar heavy equipment and the geocomposite will be unrolled by pulling down the slope. Geocomposite panels will be deployed in such a manner as to continually keep the geonet in tension. If necessary, the geocomposite will be positioned by hand after being unrolled to minimize wrinkles.
- ❑ In the presence of winds, all geocomposites will be secured by suitable methods. The temporary weighted material will be left in place until replaced with cover material as shown on the design plans and specifications.
- ❑ Cutting should be done according to Manufacturer's recommendations.
- ❑ The Installer will take necessary precautions to prevent damage to any underlying layers during placement of the geocomposite.
- ❑ During placement of geocomposites, care will be taken not to entrap any stones, excessive dust, or moisture that could cause clogging of the drainage system, and/or stones that could damage the adjacent geomembrane.

The COIA will observe and document that each of the above steps are performed by the Installer. Any noncompliance with the above requirements will be reported by the COIA to the CQA Officer.

14.2.2 Overlaps and Joining

The following requirements will be used with regard to the overlapping and joining of geocomposite rolls:

- ❑ The geonet portion of the geocomposite shall be overlapped a minimum of 4 inches. The geonet shall be joined by HDPE or nylon ties every 5 feet. At panel ends, the geonet shall be overlapped 12 inches and joined by HDPE or nylon ties every 12 inches.
- ❑ Geocomposite end seams to be covered with a strip of same geotextile (1-ft W x Panel L) after being joined by ties and heat bonded to geocomposite.
- ❑ The geotextile portion of the geocomposite shall be overlapped a minimum of 6 inches. The geotextile above the geonet shall be continuously sewn or wedge welded along the length of the roll per the Manufacturer’s recommendation.
- ❑ The Installer will pay particular attention to the overlap areas to ensure that no earthen or foreign materials could be inadvertently trapped beneath the geocomposite.
- ❑ Adjoining roll lengths in anchor trenches shall be connected using HDPE or nylon ties spaced no farther than 6 inches.

The COIA will observe and document that each of the above steps are performed by the Installer. Any noncompliance with the above requirements will be reported by the COIA to the CQA Officer.

14.2.3 Repairs

Any tears or other defects in the geocomposite will be repaired by placing a patch extending a minimum of 2 feet beyond the edges of the hole or tear. The patch will be secured to the original geocomposite by tying the geonet component every 6 inches and heat bonding or sewing the geotextile component. If the tear or other defect width is more than 50 percent of the roll width, the damaged area will be cut out and replaced with new geocomposite material. Tying devices will be as indicated above. The COIA will examine and document that the repair of any geonets is performed according to the above procedure.

14.3 Post-Installation

14.3.1 Final Examination

The COIA will perform a final geocomposite examination after installation of each geocomposite layer has been completed. The objectives of this step are as follows:

- ❑ Examine for presence of tears or defects
- ❑ Examine overlaps to make certain that they are in conformance with the requirements.

If any portion of the geocomposite requires repairs due to the above examination, they will be performed according to the procedures established for that portion.

If there will be an extended time delay between completion of the geocomposite and the start of the installation of any overlying cover, the Installer will make provisions, by using a temporary covering or other suitable methods, to protect the upper geotextile component against exposure to sunlight and ultraviolet radiation.

14.3.2 Placement of Soil Materials

The Construction Contractor will place all soil materials located on top of a geocomposite in such a manner as to minimize the following:

- ❑ Damage of the geocomposite
- ❑ Slippage of the geocomposite on underlying layers
- ❑ Tensile stresses
- ❑ Time delays due to inclement weather or construction sequencing to the extent practical

15.0 PIPING

This section of the CQA Plan applies to piping used throughout the facility. Piping will be used for conveying leachate from the leachate extraction system and landfill gas and condensate from gas extraction system. Piping will also be used to collect and discharge water from the final cover drainage layer.

Quality assurance efforts relating to the manufacturing, fabricating, delivery, initial on-site handling, installation and Post-Construction observations will be the responsibility of the COIA.

This section is divided into three major subheadings, which cover the QA requirements for the Pre-Installation (includes piping Manufacturers and fabricators), Installation, and Post-Installation (includes the final observation and documentation of piping installations prior to installation of other materials over and around the pipe). The terms Pre-Installation, Installation, and Post-Installation are applicable only to the piping installation and do not apply to the overall construction.

As a typical representation of the piping to be used throughout the facility, pipes will be SDR 17 and will range in size from 2 inches to 24 inches in diameter depending upon the required piping application. Individual pipe sizes and standard dimension ratios (SDRs) to be used for each individual pipe installation are not detailed in this section; the plans and specifications should be used for the determination of correct size and wall thickness.

15.1 Pre-Installation

This section describes the QA measures that are applicable to the polyethylene (PE) or polyvinyl chloride (PVC) resin Manufacturers, piping manufactures, piping fabricator used to perforate the pipe, and finished piping delivery to the site prior to installation.

15.1.1 Manufacturing

<u>Material Specifications</u>

The HDPE pipe used must be made from extra high molecular weight polyethylene (PE) resin, and the manufactured piping must be classified as Type III, Class C, Category 5, Grade P34 material according to ASTM D1248 and also have a cell classification of 345464C as defined by ASTM D3350. The PVC pipe and fittings used shall be manufactured from a PVC compound which meets the requirements of Cell Classification 12454-B polyvinyl chloride as outlined in ASTM D-1784. Pipe shall be free of paint or other surface treatment.

<u>Fabricator</u>

The Piping Fabricator will be responsible for perforating the pipe delivered by the Piping Manufacturer according to the plans and specifications. The Piping Fabricator will be responsible for preparing and shipping the perforated pipe to the job-site.

15.1.2 Delivery, Handling, and Storage of Piping

The pipe will be protected, during shipment, from excessive heat or cold, puncture, or other damaging or deleterious conditions. The pipe will be stored on-site in a manner suitable to protect it from long-term ultraviolet exposure prior to actual installation.

The COIA will be responsible throughout the pre-construction, construction, and post construction periods for observing and documenting that the Installer provide adequate handling equipment for moving pipe and that the equipment and handling methods used do not pose any risk of damage. The contractor is responsible for means and methods to implement the work. The COIA will document that the Manufacturer and the type and size of each pipe is correct.

15.2 Installation

This section describes the requirements applicable to pipe installation. This section includes installation, testing, observations, and documentation of piping installation.

15.2.1 Pipe Seams

Unless approved otherwise by the CQA Officer, HDPE pipe seams will be made by the butt fusion procedure in accordance with Manufacturer's specifications. Care will be taken to make certain adequate pressures are used for fusing pipes and that sufficient cooling periods are allowed prior to testing, bending, or backfilling a pipe section. Unless approved otherwise by the CQA Officer, PVC pipe seams will be in accordance with ASTM D-2855. A coating of CPS primer as recommended by pipe supplier shall be applied to the entire interior surface of the fitting socket, and to an equivalent area on the exterior of the pipe prior to applying solvent cement. The solvent cement shall comply with the requirements of ASTM D-2564 and shall be applied in strict accordance with Manufacturer’s specifications.

15.2.2 Placement Requirements

Pipe placement will be done in accordance with the following procedures and requirements:

- ❑ Piping placement will not be performed in the presence of excessive moisture. The COIA will document that this condition is fulfilled. Additionally, the COIA will document that the supporting backfill has not been damaged by weather conditions. The COIA will inform the CQA Officer if any of the above conditions are not fulfilled for evaluation of the necessity of corrective action.
- ❑ The prepared surface underlying the piping has not deteriorated since previous acceptance, and it is still acceptable immediately prior to piping placement.
- ❑ Each piping system will be flushed with water. The COIA will observe and document that each flushing operation is carried out and will document that the pipes are free flowing. Any system that does not flush properly will be immediately reported to the CQA Officer, and corrective action will be taken to remedy the problem.
- ❑ Method used to place the piping does not cause damage to the piping and does not disturb the supporting backfill.
- ❑ The COIA will observe and document all pipe installation. Deviations from the plans and specifications will be brought to the attention of the CQA Officer for evaluation of the necessity of corrective action.

- Observations and measurements should be made to ensure that the pipes are the specified size, manufactured of the specified material, and that pipe perforations are sized and spaced as specified.
- All piping should be located as noted in the plans and specifications. Locations, grades, and size requirements are specified on the details of the plan set. Observations and surveying measurements should be made to insure the pipes are placed at the specified locations and grades, and the specified configuration. Observations should be made throughout the construction to ensure that backfilling is completed as specified in the plans and specifications and that, in the process, the pipe network is not damaged.
- Non-perforated pipe will be pressure tested: Landfill gas and gravity flow leachate pipes shall be pressure tested at 5 psi for 60 minutes; condensate pipe and forcemain pipes shall be pressure tested at 50 psi for 60 minutes; air supply lines shall be pressure tested at 120 psi for 60 minutes.

15.2.3 Damages

The COIA will examine each pipe after placement for damage. Damaged pipes or portions of pipes which have been rejected will be marked and removed from the installation area and documented by the COIA.

15.3 Post-Installation

Pipe inverts (or top of pipe elevations) and coordinate locations shall be surveyed at 50- foot intervals and at all tee connection locations. The maximum allowable tolerance for grade is 0.10 feet at each location. The minimum average slope shall be in accordance with the design drawings.

16.0 SURFACE WATER CONTROL FACILITIES

The CQA Plan applies only to permanent surface water control facilities, including retention basins, overflow structures, culverts, ditches, riprap, erosion matting, diversion berms, flumes, and velocity dissipaters. Temporary facilities such as silt fencing and temporary diversion berms are not subject to the requirements of this CQA Plan but may be subject to the facility's SWPPP.

16.1 Procedures and Observation

Construction observation by the COIA will be required for some, but not all, drainage facilities. Generally, construction observation will be required for drainage features that will be backfilled and cannot be subsequently documented. This will be the case for culverts greater than 50 feet in length and any required undercuts, i.e., undercut for riprap placement, etc. Other structures, including basins, ditches, and diversion berms, can be documented in-place following construction as soil testing will not be required for these structures.

The following procedures and observations will be used for the construction of surface water drainage facilities.

- ❑ Detention basins will be constructed by excavating soils to the designed basin grades.
- ❑ Drainage ditches will be constructed by excavation of existing soils along the ditch alignment.
- ❑ Low-permeability soil cover quality soil will be used for construction of diversion berms. The Construction Contractor shall employ reasonable compaction procedures; however, soil testing will not be required.
- ❑ The Construction Contractor shall employ reasonable compaction procedures for backfilling culverts; however, soil testing will not be required.
- ❑ The COIA will observe the placement of filter fabric below riprap areas.
- ❑ The COIA will field verify the placement of erosion matting.
- ❑ The COIA will observe the installation of basin overflow structures and verify components and sizes. Backfill procedures will be observed to verify reasonable compaction; however, testing will not be required.
- ❑ Low-permeability soil cover quality soil will be used for construction of spillway berms. The Construction Contractor shall employ reasonable compaction procedures; however, soil testing will not be required.

16.2 Surveying and Acceptance Criteria

Adequate survey information shall be obtained in the field following basin construction to plot the basin contours and prepare a record drawing. If a post- construction aerial topo is obtained, the topo will be supplemented with key spot elevations obtained from this survey. The survey information shall be sufficient enough for the CQA Officer to certify that basin construction has been completed within reasonable conformance with the design plan. The following tolerances will be observed:

- ❑ The tolerance for ditch invert elevations will be ±0.2 feet, providing positive drainage is maintained.

- ❑ Tolerance for diversion berm flow line elevations will be ±0.2 feet, providing positive drainage is maintained.
- ❑ Culvert invert elevations will be surveyed every 50 lineal feet (minimum), and culvert sizes will be field verified. The tolerance for culvert invert elevations will be ±0.1 feet, providing positive drainage is maintained.
- ❑ The subgrade and top of riprap areas will be measured at sufficient locations to verify the required thickness of riprap placement.
- ❑ Key components of basin overflow structures will be surveyed, including culvert inverts and inlet elevations. The tolerance for these elevations will be ±0.1 feet, providing positive drainage is maintained.

16.3 Deviations

The surface water design may be modified based upon unexpected conditions encountered in the field. Deviations from the designs that occur during construction/installation of stormwater runoff control structures shall be noted on the record drawings and accompanied by calculations showing that the hydraulic carrying capacity remains sufficient and erosion control principles were followed. Such deviations may include, but not be limited to, alternate slopes, locations, cross-sections, points of discharge and methods of erosion control.

17.0 GAS EXTRACTION WELLS

This section of the CQA Plan applies to standard gas extraction wells and vertical gas extraction caisson wells. Perforated high-density polyethylene (HDPE) or Polyvinyl Chloride (PVC) piping will be used for construction of the gas extraction wells. Horizontal gas extraction piping will be installed in accordance with the requirements in Section 15.0 of this CQA Plan.

Individual pipe sizes and standard dimension ratios (SDRs) to be used for each individual well installation are not detailed in this CQA Plan, rather the design and construction drawing plans should be used for the determination of correct size and wall thickness.

The CQA Officer will verify that all of the following specifications are met during installation of the gas extraction wells. Prior to start-up of a new segment of the landfill gas monitoring system, it should also be verified that all components of the system are functioning appropriately. Zion Landfill maintains a facility air permit and obtains air construction permits for modifications or expansions of the landfill gas collection system. Prior to installation of new sections of the landfill gas monitoring system, Zion Landfill will obtain IEPA Division of Air Pollution Control approval of CQA specifications for landfill gas collection system construction, installation, and monitoring procedures. Prior to system start-up, Zion Landfill will verify that the system is operating in compliance with the requirements of the facility's approved air permit.

17.1 Installation of Gas Extraction Wells

The CQA Officer will observe well installation activities for conformance with the following procedures:

17.1.1 Drill or Bore Extraction Wells

The gas extraction wells will be drilled with minimum 36-inch diameter augers at the locations shown on the Drawings and to the total depth of the waste as directed by the CQA Officer. The CQA Officer (or surveyor) will survey and record the coordinates and surface elevation at each borehole location and obtain the corresponding landfill base elevation using available information. The depth to the landfill base will be calculated and provided to the driller. The driller will carefully monitor the auger depth and end each boring 10 feet from the landfill base. The actual location of the well may be adjusted if difficulty in drilling is encountered (rock, cables, metal, etc.) with approval of the CQA Officer. All wells will be drilled without drilling fluids.

All boreholes, regardless of depth, will be covered by plywood, barricaded, surrounded by orange safety mesh, or otherwise secured. Immediately after drilling and until completion of the well seal, an earthen berm around the borehole will be constructed and maintained to divert stormwater. All wells will be completed immediately after drilling to prevent loss of holes due to sloughing.

17.1.1.1 Waste Disposal

Drill cuttings shall be loaded and transported by the end of each day to the working face of the landfill and/or covered with approved daily cover or alternative daily cover material.

17.1.1.2 Well String

The well string is to be fabricated after completion of the boring and determination of actual well depths. This will allow for proper determination of perforated pipe length and proper finished elevation for the wellhead.

The well string, consisting of perforated and solid sections of HDPE or PVC pipe, will be joined together using the butt fusion process or glued and lag bolted, respectively according to the pipe Manufacturer specifications. A copy of the recommended fusion procedure supplied by the Manufacturer of the pipe used will be maintained on site at all times. The CQA Officer will inspect fused joints on the well string. Unacceptable joints will be cut out and re done.

The well string will be placed into the borehole and suspended. The well string will be centered and held in tension by the use of blocks, chains, etc., until the entire gravel pack and well seal has been installed.

17.1.1.3 Gravel Pack

The casing and gravel pack will be installed in the wells as soon as drilling is completed to prevent the loss of the holes due to sloughing.

The 1"- 3" stone should be carefully poured into the annular space. Care should be taken to keep the gravel clean and to keep the well string centered as much as possible. The gravel pack should be installed to a minimum of 1 foot above the perforations.

17.1.1.4 Geonet Layer and Lower Bentonite Plug

A geonet with heat bonded geotextile on one side shall be installed above the gravel pack to isolate the bentonite plug or seal from the gravel.

Following placement of the isolation layer, the lower bentonite plug is to be installed as follows:

- ❑ The lower well seal will be formed by evenly distributed one 50 lb. bag of dry Baroid "Benseal" or an approved equal around the annulus of the well and then adding 5 gallons of fresh water in a manner that will allow for a thorough saturating of the bentonite material. This process will be continued until a minimum plug thickness of three feet has been achieved.
- ❑ For proper installation of this well plug, the bentonite material must be placed evenly around the annulus before hydrating or gelling.

17.1.1.5 Soil Backfill

Above the lower bentonite plug, the boring annulus shall be backfilled with soil backfill up to the level indicated on the Drawings. Care must be taken in order to distribute the backfill around the annulus in a manner to provide as much compaction as possible.

17.1.1.6 Upper Bentonite Plug

Formation of the upper bentonite plug will be achieved in the same manner as described for the lower bentonite plug. A minimum thickness of 3 feet shall be achieved. The intent of this top plug is to tie into the existing cover or material while providing a positive seal against the well pipe. Actual field conditions encountered may require various adjustments or modifications to the plug as designed.

17.1.1.7 Well Completion

The wellhead assembly, or approved equal, will be attached to the pipe casing with a flexible coupling and stainless steel clamps. The lateral shall be connected with flex hose, clamps and a flexible coupling. After installation of the header system, lateral connections will be made to the well heads and the remote wellheads for the leachate cleanout risers.

17.1.2 Caisson Wells

Vertical gas extraction caisson wells may be installed in the landfill. Well construction may commence at either the top of the constructed granular drainage layer or installed after several lifts of waste. The primary components of the caisson well include a perforated well casing pipe for gas extraction, caisson pipe, and coarse aggregate. Caisson wells are similar to a traditional standard well; however, a perforated pipe will be used for the entire length of the well casing pipe until final conversion to a standard well.

For caissons installed starting from the top of the granular drainage layer, caisson well construction consists of placing of a minimum 3-foot diameter 10-foot tall column of coarse aggregate on the granular drainage layer. The stone column is constructed during initial waste placement. The well casing pipe and caisson pipe will be placed on top of the coarse aggregate column, and the annular space between the caisson and well casing pipes will be backfilled with coarse aggregate. The caisson pipe will typically be constructed of 36-inch HDPE pipe with an HDPE flange adapter welded to the top of the pipe. A larger diameter PVC slip cap will be temporarily placed on top of the perforated well casing pipe to inhibit deleterious materials and foreign objects from entering the well casing. Once the caisson is placed and backfilled with stone, the PVC slip cap will be removed, and the caisson top assembly will be placed over the perforated pipe.

Caisson wells that are installed after multiple waste lifts, an additional 20-foot by 20-foot coarse aggregate pad is centered above and in direct contact with the minimum 3-foot diameter 10-foot tall coarse aggregate column on the granular drainage layer. The stone pad is typically a minimum 2-feet thick and constructed during the initial waste lift placement. After the waste mass reaches the designated thickness over the stone pad, the caisson well is drilled in the same manner as traditional drill or bore extraction wells in Section 17.1.1 to the stone pad. The well casing pipe is placed, the borehole is backfilled with coarse aggregate and the caisson pipe and flange adapter installed per the design drawings.

Caissons wells will be raised as waste elevation increases. At the commencement of each caisson raising event, if necessary, the well will be disconnected from the gas collection and control system and the vacuum lateral riser will be properly capped and sealed. The caisson top will then be unbolted to expose the interior well casing pipe. With the perforated well casing pipe exposed, additional perforated pipe will be glued and lag bolted onto the existing well.

Once the perforated well casing pipe is extended, the caisson assembly will be gradually pulled up out of the waste mass using an excavator or equivalent. Waste will be placed around the raised caisson pipe at the required elevation for stability and protection during site operations. Once raised, additional stone will be placed in the annular space between the caisson and well casing pipes as needed. When the caisson top is reinstalled at the end of each raising event and bolted down, a flexible coupling and wellhead will be placed on the top of the caisson to allow the well to be placed into service for landfill gas extraction.

As waste reaches final grades, the caisson wells will be converted to standard wells, including installation of the geonet, bentonite plugs and solid pipe lengths consistent with design details. The caisson pipe will be permanently removed and the converted well will be added to the landfill gas collection network.

17.1.3 Documentation

The CQA Officer, with assistance from the Installer, will prepare an installation log for each extraction well including the following information:

- ❑ Number of Well Boring (from Site Plan Drawing)
- ❑ Date of Boring
- ❑ Total Depth of Boring
- ❑ Ground Surface Elevation
- ❑ Soil/Waste Profile
- ❑ Well Completion Details (including perforated length)
- ❑ Waste Temperature
- ❑ Other

18.0 SEEDING, FERTILIZING, AND MULCHING

Specifications for vegetative work shall follow Sections 250 and 251, “Seeding” and “Mulching”, in the Illinois Department of Transportation (IDOT) Standard Specifications for Construction. Seeding mixture should comply with Table 1 or equivalent as approved by the Engineer, with the specific seed mixture to be determined based on the planting time and location (sloped or flat area).

19.0 LEACHATE STORAGE TANKS

Specifications and installation requirements for the Leachate Storage Tanks will be based on the specific project and need at the time, type of tank chosen (i.e., shop fabricated, bolted, single-walled, double-walled, etc.), and the material of construction (i.e., steel, fiberglass, etc.). Once the type of tank and material of construction is decided for a given specific application, the Facility will prepare applicable specifications and installation requirements. Installation will also be done in accordance with the Manufacturer's specifications.

By field observations, review of the Manufacturer's literature and installation guidelines, the CQA Officer will document tank installation and tank capacity, leachate compatibility, secondary containment and tank integrity. Secondary containment volume should be equal to 110% of the capacity of the largest tank within each secondary containment structure.

20.0 MATERIAL ACCEPTANCE SPECIFICATION TABLES

Table 1 60-mil Textured HDPE Geomembrane Acceptance Specifications			
Properties	**Test Method**	**Required Values (14)**	**CQA Test Frequency**
Thickness mils (min. ave.) (1) (CT) • Lowest individual for 8 of 10 • Lowest individual, any of 10	D5994	60 mil (15) 57 mil (15) 57 mil (16)	1 per Roll
Asperity Height mils (min. ave.) (2) (CT)	D7466	20 mil	1 per 2 Rolls (3)
Sheet Density (min. ave.) (CT)	D1505/D792	0.940 g/cc	1 per 200,000 lb
Tensile Properties (min. ave.) (4) (CT) • Yield strength • Break strength • Yield elongation • Break elongation	D6693 Type IV	126 lb/in. 90 lb/in. 12% 100%	1 per 20,000 lb
Tear Resistance (min. ave.) (CT)	D1004	42 lb	1 per 45,000 lb
Puncture Resistance (min. ave.) (CT)	D4833	90 lb	1 per 45,000 lb
Stress Crack Resistance (5)	D5397 (App.)	500 hr	(13)
Carbon Black Content (range) (CT)	D4218 (6)	2.0-3.0%	1 per 20,000 lb
Carbon Black Dispersion (7) (CT)	D5596	(7)	1 per 45,000 lb
Oxidative Induction Time (OIT) (min. ave.) (8) • Standard OIT or • High Pressure OIT	D8117 D5885	100 min. 400 min.	1 per 200,000 lb (13)
Oven Aging at 85ºC (8) (9) • Standard OIT (min. ave.) - % retained after 90 days or • High Pressure OIT (min. ave.) - % retained after 90 days	D5721 D8117 D5885	55% 80%	1 per each formulation (13)
UV Resistance (8) • Standard OIT (min. ave.) (11) or • High Pressure OIT (min. ave.) - % retained after 1600 hrs (12)	D7238 D8117 D5885	N.R. (11) 50% (12)	1 per each formulation (13)
Required Peak Interface Friction Value (17)	D5321	See Table 12	1 per combination of materials in liner system cross-section per construction period

(CT) Conformance testing shall be performed on the geomembrane material by a 3rd party laboratory for these properties only, at the rates shown above in Table 1.
(1) Lowest reading ≥57 mil.
(2) Asperity height is owner designated and exceeds GRI GM-13, Rev. 16.
(3) Alternate the measurement side for double sided textured sheet.
(4) Machine direction (MD) and cross machine direction (XMD) average values should be on the basis of 5 test specimens each direction.
- Yield elongation is calculated using a gage length of 1.3 inches.
- Break elongation is calculated using a gage length of 2.0 inches.

(5) The SP-NCTL test is not appropriate for testing geomembranes with textured or irregular rough surfaces. Test should be conducted on smooth edges of textured rolls or on smooth sheets made from the same formulation as being used for the textured sheet materials.
(6) Other methods such as D 1603 (tube furnace) or D 6370 (TGA) are acceptable if an appropriate correlation to D 4218 (muffle furnace) can be established.
(7) Carbon black dispersion (only near spherical agglomerates) for 10 different views:
- 9 in Categories 1 or 2, and
- 1 in Category 3

Table 1 Notes Continued:

(8) The manufacturer has the option to select either one of the OIT methods listed to evaluate the antioxidant content in the geomembrane.
(9) It is also recommended to evaluate samples at 30 and 60 days to compare with the 90 day response.
(10) The condition of the test should be 20 hr. UV cycle at 75oC followed by 4 hr. condensation at 60oC.
(11) Not recommended since the high temperature of the Std-OIT test produces an unrealistic result for some of the antioxidants in the UV exposed samples.
(12) UV resistance is based on percent retained value regardless of the original HP-OIT value.
(13) Manufacturer shall provide certification letter.No CQA Testing is Required.
(14) Based on GRI GM-13, Rev. 16. Current GRI standards shall be used in the event of changes to the GRI specifications.
(15) IEPA regulations are more stringent than GM-13, Rev. 16, specification of 57 mil.
(16) IEPA regulations are more stringent than GM-13, Rev. 16, specification of 51 mil.
(17) See Table 12 for shear strength acceptance criteria.

Table 2 60-mil Textured HDPE Geomembrane Seam Testing Summary			
Properties	**Test Method (3)**	**Minimum Field and Lab Test Frequency**	**Acceptance Criteria**
Shear Test (2)	ASTM D6392 (excl. Section 6.3, “Conditioning”) GRI GM19a	1 test per 500 lf and at least 1 test per seaming crew per day	See GRI GM19a, Rev. 10 or current version at time of construction.
Peel Test (2) Hot Wedge Fusion	ASTM D6392 (excl. Section 6.3, “Conditioning”) GRI GM19a	1 test per 500 lf and at least 1 test per seaming crew per day	See GRI GM19a, Rev. 10 or current version at time of construction.
Peel Test Fillet Extrusion	ASTM D6392 (excl. Section 6.3, “Conditioning”) GRI GM19a	1 test per 500 lf and at least 1 test per seaming crew per day	See GRI GM19a, Rev. 10 or current version at time of construction.
Air-Pressure	ASTM D5820	All dual track seams tested by Air Pressure	<3 psi drop in 5 minutes with initial pressure 25-30 psi, following an initial relaxation period.
Vacuum	ASTM D5641	All single track wedge and extrusion seams tested by Vacuum	Examine weld for approximately 10 seconds through window at vacuum of minimum 3 psig

(1) Locus of break codes are provided in ASTM D6392 and GRI GM19a, Rev. 10. Current GRI standards shall be used in the event of changes to the GRI specifications.
(2) For double fusion welded seams, both tracks shall be tested for compliance with minimum property values listed above.
(3) Destructive seams will be evaluated for strength parameters according to ASTM D6392 (excluding section 6.3 “Conditioning”) and GRI GM19a. Destructive seams will be evaluated for elongation during cold weather seaming. Refer to Cold Weather Operations section of CQA Plan.

Table 3 40-mil Textured LLDPE Geomembrane Acceptance Specifications			
Properties	**Test Method**	**Required Values (12)**	**CQA Test Frequency**
Thickness mils (min. ave.) (CT) • Lowest individual for 8 of 10 • Lowest individual for any of 10	D5994	40 mil (13) 38 mil (14) 38 mil (15)	1 per Roll
Asperity Height (min. ave.) (1)(2) (CT)	D7466	20 mil	1 per 2 Rolls
Sheet Density (max.) (CT)	D1505/D792	0.939 g/cc	1 per 200,000 lb
Tensile Properties (min. ave.) (3) (CT) • Break strength • Break elongation	D6693 Type IV	60 lb/in. 250%	1 per 20,000 lb
2% Modulus (max.)	D5323	2400 lb/in	1 per each formulation (11)
Tear Resistance (min. ave.) (CT)	D1004	22 lb	1 per 45,000 lb
Puncture Resistance (min. ave.) (CT)	D4833	44 lb	1 per 45,000 lb
Axi-Symmetric Break Resistance Strain (min.)	D5617	30%	1 per each formulation (11)
Carbon Black Content (range) (CT)	D4218 (4)	2.0-3.0%	1 per 45,000 lb
Carbon Black Dispersion (5) (CT)	D5596	(5)	1 per 45,000 lb
Oxidative Induction Time (OIT) (min. ave.) (6) • Standard OIT, or • High Pressure OIT	D8117 D5885	100 min. 400 min.	1 per 200,000 lb (11)
Oven Aging at 85ºC (6) (7) • Standard OIT (min. ave.), % retained after 90 days, or • High Pressure OIT (min. ave.) - % retained after 90 days	D5721 D8117 D5885	35% 60%	1 per each formulation (11)
UV Resistance (8) • Standard OIT (min. ave.) (9), or or • High Pressure OIT (min. ave.), % retained after 1600 hrs (10)	D7238 D8117 D5885	Note (9) 35% (10)	1 per each formulation (11)
Required Peak Interface Friction Value (16)(17)	D5321	See Table 12	1 per combination of materials in cover system cross-section per construction period

(CT) Conformance testing shall be performed on the geomembrane material by a 3rd party laboratory for these properties only, at the rates shown above in Table 3.
(1) Asperity Height is owner designated and exceeds GRI GM17, Rev. 14.
(2) Alternate the measurement side for double sided textured sheet.
(3) Machine direction (MD) and cross machine direction (XMD) average values should be on the basis of 5 test specimens each direction.
- Break elongation is calculated using a gage length of 2.0 inches at 2.0 in./min.

(4) Other methods such as D 1603 (tube furnace) or D6370 (TGA) are acceptable if an appropriate correlation to D 4218 (muffle furnace) can be established.
(5) Carbon black dispersion (only near spherical agglomerates) for 10 different views:
- 9 in Categories 1 or 2, and
- 1 in Category 3

(6) The manufacturer has the option to select either one of the OIT methods listed to evaluate the antioxidant content in the geomembrane.
(7) It is also recommended to evaluate samples at 30 and 60 days to compare with the 90 day response.
(8) The condition of the test should be 20 hr. UV cycle at 75°C followed by 4 hr. condensation at 60°C.
(9) Not recommended since the high temperature of the Std-OIT test produces an unrealistic result for some of the antioxidants in the UV exposed samples.
(10) UV resistance is based on percent retained value regardless of the original HP-OIT value.
(11) Manufacturer shall provide certification letter.
(12) Based on GRI GM-17, Rev. 14. Current GRI standards shall be used in the event of changes to the GRI specifications.
(13) IEPA regulations are more stringent than GRI GM 17, Rev. 14 specification of 38 mil.
(14) IEPA regulations are more stringent than GRI GM 17, Rev. 14 specification of 36 mil.
(15) IEPA regulations are more stringent than GRI GM 17, Rev. 14 specification of 34 mil.

Table 3 Notes Continued:

(16) Required interface friction value: Equivalent shear strength at anticipated normal loads (in the range of 100 to 500 psf) to achieve required design values.

(17) It is noted that a number of possible definitions of minimum material peak interface strength may exist. If a material is generally close to the minimum limit, the new data should be used in a stability model to verify the material's suitability. See Appendix J.2-A of the Site 2 North Permit Application for the acceptable window.

Table 4 40-mil Textured LLDPE Geomembrane Seam Testing Summary			
Properties	**Test Method (3)**	**Testing Frequency (minimum)**	**Acceptance Criteria**
Shear Test (2)	ASTM D6392 (excl. Section 6.3, “Conditioning”) GRI GM19a	1 test per 500 if and at least 1 test per seaming crew per day	See GRI GM19a, Rev. 10 or current version at time of construction.
Peel Test (2) Hot Wedge Fusion	ASTM D6392 (excl. Section 6.3, “Conditioning”) GRI GM19a	1 test per 500 if and at least 1 test per seaming crew per day	See GRI GM19a, Rev. 10 or current version at time of construction.
Peel Test Fillet Extrusion	ASTM D6392 (excl. Section 6.3, “Conditioning”) GRI GM19a	1 test per 500 if and at least 1 test per seaming crew per day	See GRI GM19a, Rev. 10 or current version at time of construction.
Air-Pressure	ASTM D5820	All dual track seams tested by Air Pressure	<3 psi drop in 5 minutes with initial pressure 25-30 psi, following an initial relaxation period.
Vacuum	ASTM D5641	All single track wedge and extrusion seams tested by Vacuum	Examine weld for approximately 10 seconds through window at vacuum of minimum 3 psig

(1) Locus of break codes are provided ASTM D6392 and GRI GM19a, Rev. 10. Current GRI standards shall be used in the event of changes to the GRI specifications.
(2) For double fusion welded seams, both tracks shall be tested for compliance with minimum property values listed above.
(3) Destructive seams will be evaluated for strength parameters according to ASTM D6392 (excluding Section 6.3 “Conditioning”) and GRI GM19a. Destructive seams will be evaluated for elongation during cold weather seaming. Refer to Cold Weather Operations section of CQA Plan.

Table 5 Geotextile Tests and Test Methods		
Property	**Test Methods (ASTM)**	**Conformance Testing Frequency**
Apparent Opening Size (AOS) (CT)	D4751	1 per 540,000 sf
Grab Tensile Properties -Tensile Strength -Break Elongation	D4632	-
Mass per Unit Area	D5261	-
Permittivity (2) (CT)	D4491	1 per 540,000 sf
Puncture Resistance	D4833	-
Trapezoidal Tear	D4533	-
UV Resistance	D4355	-
Water Flow Rate (2) (CT)	D4491	1 per 540,000 sf

(CT) Conformance testing shall be performed on the filter geotextile materials for these properties only.
(1) Geotextile manufacturer(s) shall provide written certification that geotextile material delivered and inventoried on site meets or exceeds material property values in tables 5, 6, 7 and 8. No additional conformance testing of received geotextiles is required to be performed.
(2) Property certified for filter geotextile application of tables 6 and 7.

Table 6 6 oz/yd^2 Filter Geotextile Acceptance Specifications			
Property	**Units**	**Type of Criterion**	**Acceptable Value (1)**
Apparent Opening Size (AOS) (CT)	mm	Minimum	0.210
Grab Tensile Properties (2) -Tensile Strength -Break Elongation	lb %	MARV	160 50
Mass per Unit Area	oz/yd^2	MARV	6
Permittivity (CT)	sec^{-1}	MARV	1.5
Puncture Resistance	lb	MARV	90 (4)
Trapezoidal Tear (2)	lb	MARV	65
UV Resistance (3)	%	Minimum	70
Water Flow Rate (CT)	gpm/ft^2	MARV	110

(CT) Conformance Testing to be performed at the rate shown in Table 5.
(1) Values are based on review of acceptable manufacturer's specifications and represent production values at the time this document was prepared.
(2) These tests will be performed and results reported in both the machine and cross directions.
(3) Evaluation to be on a 2.0 inch strip tensile specimens after 500 hours exposure.
(4) Acceptable value for ASTM D4833 testing for puncture strength.
(5) 6 oz/yd^2 Geotextile is a filter material above the coarse aggregate bedding of the underdrain collection pipe.

Table 7 8 oz/yd^2 Geotextile Acceptance Specifications			
Property	**Units**	**Type of Criterion**	**Acceptable Value (1)**
Apparent Opening Size (AOS) (CT)	mm	Minimum	0.180
Grab Tensile Properties (2) -Tensile Strength -Break Elongation	lb %	MARV	220 50
Mass per Unit Area	oz/yd^2	MARV	8
Permittivity (CT)	sec^{-1}	MARV	1.3
Puncture Resistance	lb	MARV	120 (4)
Trapezoidal Tear (2)	lb	MARV	90
UV Resistance (3)	%	Minimum	70
Water Flow Rate (CT)	gpm/ft^2	MARV	95

(CT) Conformance Testing to be performed at the rate shown in Table 5.
(1) Values are based on review of acceptable manufacturer's specifications and represent production values at the time this document was prepared.
(2) These tests will be performed and results reported in both the machine and cross directions.
(3) Evaluation to be on a 2.0 inch strip tensile specimens after 500 hours exposure.
(4) Acceptable value for ASTM D4833 testing for puncture strength.
(5) 8 oz/yd^2 Geotextile is approved as filter material above the granular drainage layer and pipe bedding for the Site 2 North Expansion.

Table 8 12 oz/yd^2 Geotextile Acceptance Specifications			
Property	**Units**	**Type of Criterion**	**Acceptable Value (1)**
Apparent Opening Size (AOS)	mm	Minimum	0.150
Grab Tensile Properties (2) -Tensile Strength -Break Elongation	lb %	MARV	 300 50
Mass per Unit Area	oz/yd^2	MARV	12
Puncture Resistance	lb	Minimum	190 (4)
Trapezoidal Tear (2)	lb	MARV	115
UV Resistance (3)	%	Minimum	70
Water Flow Rate	gpm/ft^2	MARV	60

(1) Values are based on GRI GT12(a), Rev. 2, and based on review of acceptable manufacturer's specifications and represent production values at the time this document was prepared.
(2) These tests will be performed and results reported in both the machine and cross directions.
(3) Evaluation to be on a 2.0 inch strip tensile specimens after 500 hours exposure.
(4) Acceptable value for ASTM D4833 testing for puncture strength.
(5) 12 oz/yd^2 Geotextile is a cushion material between the granular drainage layer and the 60-mil HDPE geomembrane for the Site 2 North Expansion.

Table 9 Geonet Properties				
Property	**Units**	**Acceptable Value (2)**	**Test Methods (ASTM)**	**Acceptance Criteria**
Thickness	mils	200	D5199	Min. Average
Density	g/cu cm	0.95	D1505/D792 Method B	Min. Average
Tensile Strength (MD)	lb/in	45	D5035/7179	Min. Average
Carbon Black Content	%	1.5-3.0	D1603/4218	Range
Compressive Strength	lb/in^2	120	D6364	Min. Average

(1) Testing will be performed and results reported in both the machine and cross directions.
(2) Values are based on GRI GN 4, Rev. 4, and based on review of acceptable manufacturer's specifications and represent production values at the time this document was prepared.
(3) Geonet will be part of 200-mil double-sided geocomposite.
(4) Geonet Manufacturer shall provide written certification that geonet used as part of the geocomposite delivered and inventoried on site meets or exceeds material property values in Table 9 prior to lamination.

Table 10 Geocomposite Properties(1)				
Properties	**Units**	**Acceptable Value**	**Test (ASTM)**	**Acceptance Criteria**
Top and Bottom 6 oz/yd^2 Geotextile Component				
Apparent Opening Size (AOS) (CT)	mm	0.210	D4751	Min. Average
Grab Tensile Properties (2) -Tensile Strength -Break Elongation	lb %	160 50	D4632	Min. Average
Mass per Unit Area	oz/yd^2	6	D5261	Min. Average
Permittivity (CT)	sec^{-1}	1.5	D4491	Min. Average
Puncture Resistance	lb	90 (3)	D4833	Min. Average
UV Resistance (2)	%	70	D4355	Min. Average
Water Flow Rate (CT)	gpm/ft^2	110	D4491	Min. Average
Geonet Core				
Geonet Core shall conform to the specifications in Table 9				
Completed Geocomposite				
Transmissivity (4)	gal/min/ft	0.5	D4716	Minimum
Ply Adhesion	lb/in	1.0	D7005	Min. Average

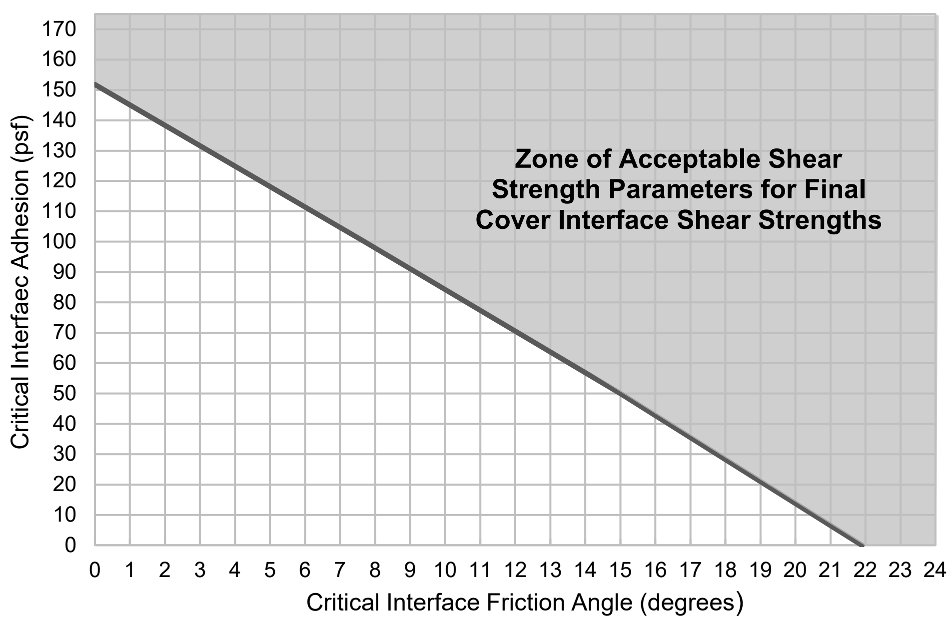
(CT) Conformance Testing of the 6 oz/yd^2 geotextile to be performed at the rate shown in Table 5.
(1) Design of the Site 2 North Expansion final cover and the underdrain system uses a double-sided geocomposite with a 6 oz/yd^2 geotextile on both the top and bottom.
(2) Tests will be performed and results reported in both the machine and cross directions.
(3) ASTM D4833 or D6241 can be utilized for conformance testing.
(4) Per the index specification, Transmissivity (ASTM D4716) of the geocomposite shall exhibit a minimum value of 0.5 gal/min/ft when tested between a geomembrane and geotextile with a gradient of 0.1 under a load of 10,000 psf and a seat time of 15 minutes. See Appendix J.5-C of the Site 2 North Expansion Permit Application to ensure the transmissivity of the geocomposite meets the required final cover transmissivity.
(5) The geocomposite shall be manufactured by heat bonding the geotextile to the geonet on both sides. No burn through geotextiles nor glue or adhesive shall be permitted. The bond between the geotextile and geonet shall exhibit an average peel strength of 1 pound per inch with a minimum peel strength 0.5 pounds per inch according to ASTM D7005.
(6) Component properties prior to lamination.
(7) Values are based on GRI GN 4, Rev. 4, and based on review of acceptable manufacturer's specifications and represent production values at the time this document was prepared.
(8) Geocomposite manufacturer shall provide written certification that geocomposite delivered and inventoried on site meets or exceeds material property values in Table 10. No conformance testing of received geocomposite is required to be performed.

Table 11 Geosynthetic Clay Liner (GCL) Properties				
Properties	**Unit**	**Acceptable Value (2)**	**Test Methods (ASTM)**	**Acceptance Criteria**
Bentonite Properties				
Swell Index	ml/2g	24	D5890	Minimum
Fluid Loss	ml	18	D5891	Maximum
Physical GCL (as manufactured)				
GCL mass per unit area (1)	lb/sf	0.81	D5993	Minimum
Bentonite mass per unit area (1)	lb/sf	0.75	D5993	Minimum
Moisture Content	%	35	D5993	Maximum
Tensile Strength (MD)	lb/in	23	D6768	Minimum
Peel Strength	lb/in	1.0	D6496	Minimum
Permeability, “or”	cm/sec	$5x10^{-9}$	D5887	Maximum
Index Flux	cm^3/sec-cm^2	$1x10^{-6}$	D5887	Maximum

(1) Mass of GCL and bentonite is measured after oven drying per the stated test method.
(2) Values are based on GRI GCL 3, Rev. 5, and based on review of acceptable manufacturer’s specifications and represent production values at the time this document was prepared.
(3) GCL manufacturer shall provide written certification that GCL delivered and inventoried on site meets or exceeds material property values in Table 11. No conformance Testing of received GCL is required to be performed.
(4) GCL material to be installed in the leachate collection sumps of the Site 2 North Expansion.

Table 12 Shear Strength Criteria				
Interface	Normal Stresses (psf)	Max. Strain Rate (in/min)	Minimum Peak Shear Strength	
			Adhesion (psf)	Friction Angle (degrees)
Final Cover System				
Protective Cover Soil vs. Double-sided Geocomposite Drainage Layer	250, 500, and 1,000	0.04	Acceptable range between 0 psf and 21.9° 151.8 psf and 0° (8)	
Double-sided Geocomposite Drainage Layer vs. 40-mil Textured LLDPE Geocomposite		0.2		
40-mil Textured LLDPE Geocomposite vs. Final Cover Barrier Soil		0.04		
Bottom Liner System (Sideslope and Floor)				
Granular Drainage Layer vs. 12-oz/yd^2 Geotextile	4,200 and 16,800 (9)	0.04	Acceptable range between 0 psf and 24.1° 45 psf and 14.9° (10)	
12-oz/yd^2 Geotextile vs. 60-mil Textured HDPE Geomembrane		0.2		
60-mil Textured HDPE Geomembrane vs. Low-permeability Earth Liner		0.04		

(1) Interface shear testing shall be performed in accordance with ASTM D5321 for the construction of the Site 2 North Expansion.
(2) Interface shall be flooded and consolidated under the Normal Stress for at least 24 hours prior to shearing. Samples shall remain flooded during shearing.
(3) The maximum strain rates may be increased by a factor of 10 following the attainment of peak strength and continue to a minimal horizontal displacement of 2 inches.
(4) The shear strength criteria for the Final Cover System apply to the lowest interface peak strength.
(5) The shear strength criteria for the Landfill Floor Liner System and Landfill Sideslope Liner System apply to peak strength.
(6) Interface shear strength criteria may be revised upon approval of the design engineer. If the interface shear strength test results are less than the minimum values reported above, additional slope stability analyses can be performed by a qualified geotechnical engineer using the interface shear test results. The test results are acceptable if these analyses demonstrate adequate factors of safety.
(7) Interface shear tests shall be performed on geosynthetic materials representative of the materials that will be used during construction. Specific rolls used during construction need not be tested.
(8) Minimum peak interface shear strength window for the final cover system was determined in the Site 2 North Expansion Permit Application for the horizontal and vertical expansion and is shown below. The peak interface shear strength test results should be within the acceptable range shown below.
(9) Test at confining stresses between 4,200 and 16,800 psf. The latter number represents the peak landfill stress column as determined by the permit application settlement analysis.



(10) Minimum peak interface shear strength window for the landfill bottom liner floor system and landfill sideslope liner system was determined in the Site 2 North Expansion Permit Application for the horizontal and vertical expansion and is shown below. The peak interface shear strength test results should be within the acceptable range shown below.

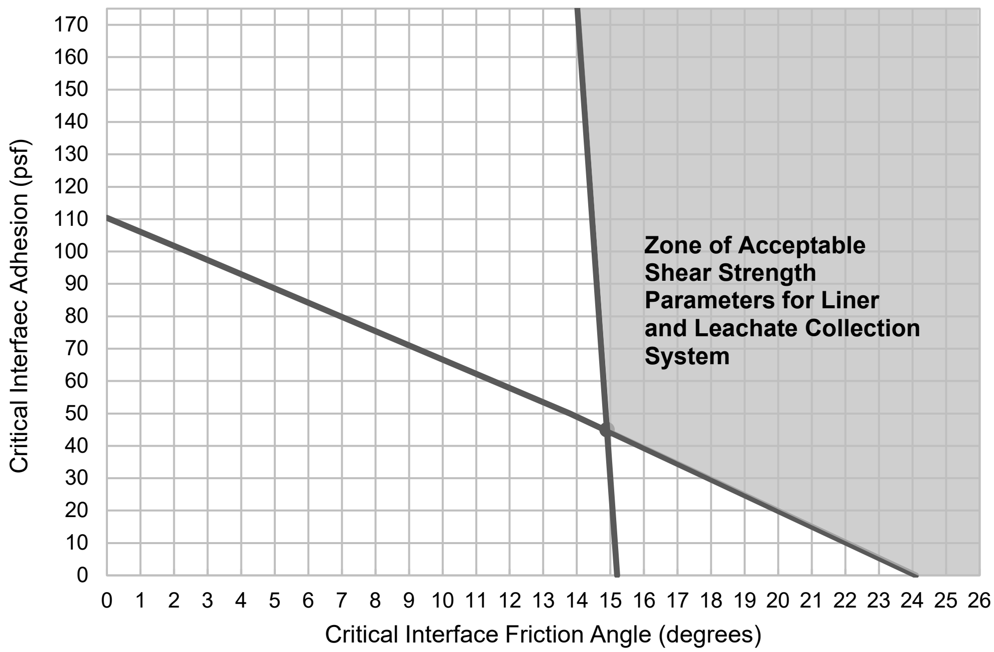


Table 13 Material Testing Methods and Frequency Summary				
Property	**Test Method**	**Minimum Testing Frequency**	**Typical Test per Lift**	**Specifications**
Landfill Foundation Subgrade (Underlies the 5' Earth Liner)				
Elevation	Survey	100' grid	-	N/A
Direct Shear or Triaxial Shear	ASTM D3080	1 test per cell construction	-	Acceptable range between 0 psf and 24.1° 45 psf and 14.9° (see window in Table 12)
Compacted Foundation Fill				
Soil Classification	D2487 (USCS)	1 test per 10,000 yd^3 or change in material type	1 test per 8 acres or per soil type	GM, GC, SC, ML, and CL
Standard or Modified Proctor	ASTM D 698 or D 1557	1 test per Source	-	Material Specific
Nuclear Density	ASTM D 6938	1 test per 1,000 yd^3	1 test per 1 acre	≥ 95% Standard Proctor OR ≥ 90% Modified Proctor
Grain Size Distribution	ASTM D6913/D7928	1 test per 10,000 yd^3	1 test per 8 acres	≥ 12% below 0.002 mm ≥ 50% below No. 200 sieve
Atterberg Limits	ASTM D4318	1 test per 10,000 yd^3	1 test per 8 acres	for ≥ 50% below No. 200 sieve PI >10 LL >20%
Lift Thickness	Visual Observation	Continuous	-	9-inch (loose) or thickness of compactor foot
Elevation	Survey	100' grid	-	N/A
Triaxial Laboratory Permeability	ASTM D5084 or SW 846-EPA Method 9100	1 test per 10,000 yd^3	1 test per 8 acres	$K \leq 1x10^{-7}$ cm/sec
Low-Permeability Earth Liner (5')				
Soil Classification	D2487 (USCS)	1 test per 10,000 yd^3 or change in material type	1 test per 8 acres or per soil type	CH, CL, CL-ML
Standard or Modified Proctor	ASTM D 698 or D 1557	1 test per 10,000 yd^3	1 test per 8 acres	Material Specific
Nuclear Density	ASTM D 6938	1 test per 10,000 ft^2 per lift	1 test per 10,000 ft^2	≥ 95% Standard Proctor OR ≥ 90% Modified Proctor
Grain Size Distribution	ASTM D6913/D7928	1 test per 10,000 yd^3	1 test per acre	≥ 50% below No. 200 sieve
Atterberg Limits	ASTM D4318	1 test per 10,000 yd^3	1 test per 8 acres	PI >10 (or PI >4 if hydraulic conductivity is ≥ 1 x 10^{-7}cm/sec) LL >20%
Lift Thickness	Visual Observation	Continuous	-	9-inch (loose) or thickness of compactor foot
Thickness	Topographic Survey	100' grid	-	≥ 5 feet nominal to surface
Elevation	Survey	100' grid	-	N/A
Triaxial Laboratory Permeability	ASTM D5084 or SW 846-EPA Method 9100	1 test per 10,000 yd^3	1 test per 8 acres	$K \leq 1x10^{-7}$ cm/sec
Internal Shear Strength (2) (4)	ASTM D 2166, D 2850, or D 4767	1 test per material type	Once per construction season or material change	Acceptable range between 0 psf and 24.1° 45 psf and 14.9° (see window in Table 12)
Sand Bedding for Granular Drainage Layer				
Soil Classification	D2487 (USCS)	1 test per 5,000 yd^3 or change in material type	-	G
Grain Size Distribution	ASTM D6913/D7928	1 test per source per phase	NA	$D_{100} \leq 1.0$ in. $D_{90} \leq 0.34$ in.
Sieve Analysis	ASTM C136	1 test per 5,000 yd^3	-	≤ 5% fines passing 200 sieve

Table 13
Material Testing Methods and Frequency Summary

Property	Test Method	Minimum Testing Frequency	Typical Test per Lift	Specifications
Hydraulic Conductivity	ASTM D2434	1 test per 5,000 yd^3	-	$K \geq 1 \times 10^{-1}$ cm/sec
Thickness	Surveying	100' grid	-	≥ 1-foot normal to surface
HDPE/PVC Pipe				
Pipe Joints	Visual Inspection, ASTM D2657	Each joint	-	Intact, no cracks, no voids in bonding
Dimensions	-	Random measurements of diameters and hole spacing, and end sections of pipe and fittings	-	Design Specifications
Northing, Easting, and Elevation	Survey	Survey every 50' or at joints	-	Tolerance of 0.10 feet
Air Pressure Testing		Pneumatic piping Leachate forcemain carrier piping Leachate forcemain containment piping Non-perforated landfill gas piping		Pressurize to at least 150 psig for at least 1 hour – No greater than 5% drop Pressurize to at least 50 psig for at least 1 hour – No greater than 5% drop Pressurize to at least 50 psig for at least 1 hour – No greater than 5% drop Pressurize to at least 5 psig for at least 1 hour – No greater than 5% drop
Visual physical properties	-	Each lot	-	Equal to manufacturer's data
Washed Gravel Envelope/Backfill for Leachate Collection (Pipe Bedding)				
Grain Size Distribution	ASTM D6913	1 test per source per phase	NA	D_{100} < 2.5 in. D_{90} < 1.35 in.
Lift Thickness	Visual observation	1 observation every 100'	-	Design Specifications
Gravel Backfill for Landfill Gas Extraction Wells				
Grain Size Distribution	ASTM D6913/D7928	1 test per source per phase	NA	1.0 in. ≤ D ≤ 3.0 in.
Final Cover Barrier Soil (2')				
Soil Classification	D2487 (USCS)	1 test per 10,000 yd^3 or change in material type	1 test per 8 acres or per soil type	CH, CL, CL-ML, ML, SC, SM/SC
Standard or Modified Proctor	ASTM D 698 or D1557	1 test per 10,000 yd^3	1 test per 8 acres	Material Specific
Nuclear Density	ASTM D6938	1 test per 10,000 ft^2 per lift	1 test per 10,000 ft^2	≥ 90% Standard Proctor OR ≥ 85% Modified Proctor
Grain Size Distribution	ASTM D6913/D7928	1 test per 10,000 yd^3	1 test per 8 acres	≥ 50% below No. 200 sieve
Atterberg Limits	ASTM D 4318	1 test per 10,000 yd^3	1 test per 8 acres	PI >4 (or PI <4 if hydraulic conductivity is ≤ 1×10^{-5} cm/sec) LL >20%
Lift Thickness	Visual Observation	Continuous	NA	9-inch (loose) or thickness of compactor foot
Thickness	Topographic Survey	100' grid or major grade breaks	NA	≥ 24-inches normal to surface

Table 13 Material Testing Methods and Frequency Summary				
Property	**Test Method**	**Minimum Testing Frequency**	**Typical Test per Lift**	**Specifications**
Elevation	Survey	100' grid	-	N/A
Triaxial Laboratory Permeability	ASTM D5084 or SW 846-EPA Method 9100	1 test per 10,000 yd^3	-	K≤$1x10^{-5}$ cm/sec
Low-Permeability Fill (Containment Berms, Temporary and Permanent Berms, Stormwater Basin Dikes, Fill Embankments) (3) (5)				
Soil Classification	D2487 (USCS)	1 test per 10,000 yd^3 or change in material type	1 test per 8 acres or per soil type	GM, GC, SC, ML, CL
Standard or Modified Proctor	ASTM D 698 or D1557	1 test per 10,000 yd^3	1 test per 8 acres	Material Specific
Nuclear Density	ASTM D6938	1 test per 1,000 yd^3	1 test per 1 acre	≥ 90% Standard Proctor OR ≥ 85% Modified Proctor
Grain Size Distribution	ASTM D6913/D7928	1 test per 10,000 yd^3	1 test per 8 acres	≥ 50% below No. 200 sieve
Atterberg Limits	ASTM D 4318	1 test per 10,000 yd^3	1 test per 8 acres	LL <60%
Lift Thickness	Visual Observation	Continuous	NA	9-inch (loose) or thickness of compactor foot
Elevation	Survey	100' grid	-	N/A
Triaxial Laboratory Permeability	ASTM D5084 or SW 846-EPA Method 9100	1 test per 10,000 yd^3	-	Detention basin sidewalls K≤$1x10^{-5}$ cm/sec
Internal Shear Strength When Placed on Slopes Greater than 4H:1V (4)	ASTM D 2166, D 2850, or D 4767,	1 test per material type	Once per construction season or material change	1.0 tsf
Final Cover Protective Layer (General Soils)				
Soil Classification	D2487 (USCS)	1 test per 10,000 yd^3 or change in material type	1 test per 8 acres or per soil type	GM, GC, SC, ML, CL
Thickness (1)	Topographic Survey	100' grid or major grade breaks	NA	≥ 36" normal to surface[1]
Internal Shear Strength (4)	ASTM D 2166, D 2850, or D 4767	1 test per material type	Once per construction season or material change	Acceptable range between 0 psf and 21.9° 151.8 psf and 0° (see window in Table 12)

Table 13 Notes:

(1) The upper six (6) inches of the random fill used for the final cover protective layer must be capable of supporting vegetation, else the upper six (6) inches must consist of topsoil.
(2) Minimum peak interface shear strength windows were determined in the Site 2 North Expansion permit application. See Note 8 and 9 in Table 12 for the acceptable range of the final cover and bottom liner interface values.
(3) Stormwater berms on the final cover do not need to meet the testing requirements of this section.
(4) CQA Officer has the discretion to forgo Internal shear strength testing provided the previous test liner results satisfy the material requirements specified in Table 13.
(5) Testing criteria for low-permeability fill applies to the listed site features only (Containment Berms, Temporary and Permanent Berms, Stormwater Basin Dikes, Fill Embankments).

21.0 FORMS

OFFICER-IN-ABSENTIA
Zion Landfill

Date: ____________________________

Operator and Owner: ____

Contractor: ____

Third-party CQA Firms: ____

____

Description of Construction: ____

CQA Officer: ____

Period of Designated Authority: ____

Reason for CQA Officer's Absence: ____

____

____

The undersigned understand and agree to the following:

Until further notice,__________________________________has been designated as the CQA Officer-in- Absentia as described above, and as such, shall exercise professional judgement in fulfilling the CQA Officer's duties as described in the site's CQA Plan. The CQA Officer assumes full personal responsibility for the performance of all inspections and reports prepared by, or under the direction of, the designated CQA Officer-in-Absentia.

CQA Officer

__________________________ Signature __________________________ Date

__________________________ Print Name

CQA Officer-in-Absentia

__________________________ Signature __________________________ Date

__________________________ Print Name

Operator/Owner

__________________________ Signature __________________________ Date

__________________________ Print Name

NOTE: This form (or similar) must be fully completed and must accompany the Construction Documentation Report.

ATTACHMENT 7
Revised Appendix S – Closure and Post-Closure Care Plan

ZION LANDFILL, INC.

ZION, ILLINOIS

CLOSURE AND POST-CLOSURE PLAN

May 2022

CLOSURE AND POST-CLOSURE CARE PLAN

TABLE OF CONTENTS

EXHIBITS

1.0 INTRODUCTION

This Closure and Post-Closure Care Plan (Plan) describes the closure and post-closure care activities that Zion Landfill, Inc. (Landfill) will perform at the expanded landfill (Site 2 North Expansion). The Plan has been developed to meet the closure and post-closure care plan requirements stipulated in 35 IAC Section 812.114 and 35 IAC Section 812.115 and address the requirements of 35 IAC Section 811.110, 35 IAC Section 811.111, and 35 IAC Section 811.704.

This Plan details the steps necessary for the proper closure of the expanded Landfill in the event of an unplanned, premature closure of the Landfill as well as under the planned, routine closure of the Landfill. Schedules are provided for both of these scenarios. In addition, the steps necessary to care for the Landfill during the post-closure period are described. Cost estimates are presented for closure and post-closure activities, and financial assurance mechanisms (to ensure that funding is available to complete those activities) are described. The Closure Plan is provided in Section 2, and the Post-Closure Care Plan is provided in Section 3. Section 4 provides Closure and Post-Closure Care Cost Estimates.

Drawing D11 shows the configuration of the facility after closure of all phases, including the approximate contours of the final topography of the expanded Landfill. It is noted that the landfill will be closed incrementally and settlement is anticipated to occur after closure. Therefore, the final topography may vary from the topography shown to allow each area being closed to tie into adjacent closed areas. The location of all facility-related structures that will remain as permanent features after closure are also shown on this drawing. Details of the final cover and stormwater management system designs are shown on **Drawing D13** and **Drawings D20 through D25**. The locations of environmental monitoring points are shown on **Drawing D12**, and the location and details of the conceptual landfill gas management system are shown on **Drawing D14** and **Drawings D26 through D27**.

2.0 CLOSURE PLAN (812.114)

2.1 Routine Closure Activities

Routine closure is closure at the end of the intended operating life. Routine closure of the expanded Landfill is estimated to occur in the year 2044[1].

Activities necessary to close the Landfill at the end of the intended operating life are detailed below:

Equipment Decontamination: Equipment decontamination will consist of removing accumulated waste and pressure washing the Landfill equipment that has been in contact with the waste. Wash waters will be collected and either solidified and disposed at the Landfill, or transported to an offsite wastewater treatment plant for treatment and disposal. Equipment used to construct the final cover will not contact waste and, therefore, will not require decontamination.

Remove All Unnecessary Equipment and Structures: All equipment and structures that are not necessary for the post-closure land use will be removed. This will include removing the scales and Landfill operations equipment not necessary for post-closure maintenance activities. If appropriate, buildings such as the office and maintenance buildings may remain onsite to facilitate post-closure care, at the discretion of the Owner.

Gas Monitoring, Collection and Control System Components: The gas monitoring, collection and control system will be installed during the Landfill operating period and remain operational at least 30 years after closure and may be discontinued only after conditions described in 35 IAC Section 811.310(c)(4) have been achieved. Any remaining gas collection devices and associated piping will be installed during routine closure, as necessary. The conceptual locations of the gas monitoring, collection and control systems are illustrated on **Drawing D14**; conceptual details are shown on **Drawings D26 through D27**. The location and details may be modified as appropriate and as approved by the Illinois EPA. Construction procedures are contained in the Construction Quality Assurance (CQA) Plan.

Final Cover Subgrade Preparation: The final cover subgrade will consist of a 12-inch minimum thickness intermediate cover soil layer. The majority of the intermediate cover soil layer will have been placed as part of Landfill operations. Additional soil will be placed as needed to attain the full 12-inch thickness.

Final Cover Recompacted Soil Layer: A 24-inch minimum thickness low-permeability barrier soil layer will be placed over the one foot of intermediate cover soil. The low-permeability barrier soil layer will be compacted and placed to meet requirements specified in the CQA Plan. Construction details are illustrated on **Drawing D20**; material, placement and compaction requirements are provided in the CQA Plan.

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1 The intended operating life is calculated based on projected annual waste receipts from the service area.

Geomembrane Installation: A 40-mil linear low-density polyethylene (LLDPE) geomembrane will be placed over the final cover barrier soil in all areas that have received waste. Details are illustrated on **Drawing D20**. Geomembrane material and installation requirements are provided in the CQA Plan.

Geocomposite Drainage Layer: A geocomposite drainage layer, consisting of a geonet sandwiched between two non-woven needle-punched geotextiles, will be placed immediately above the geomembrane. Construction details are illustrated on **Drawing D20**; material and installation requirements are provided in the CQA Plan.

Protective Cover Soils Layer: A protective cover capable of supporting vegetation, at least 3 feet thick, will be placed over the geocomposite drainage layer. The protective layer will consist of at least 30 inches of general soils meeting requirements specified in the CQA plan and 6 inches of topsoil (i.e. soil capable of supporting vegetation). The protective layer will be placed as soon as possible following installation of the geocomposite drainage layer to prevent desiccation, cracking, freezing or other damage to the subgrade, final cover barrier soil, geomembrane, and geocomposite drainage layer. Details are illustrated on **Drawing D20**. Protective cover soils material, placement and compaction requirements are provided in the CQA Plan.

Seed and Mulch: The final cover and borrow area will be seeded and mulched. Erosion controls and sediment controls, such as silt fencing, erosion control mats, wattles, etc. will be placed as required to minimize erosion until the vegetation becomes established. Seeding and mulching will be conducted in accordance with of the CQA Plan.

Stormwater Management Structures: Stormwater management structures that will be constructed at closure consist of slope drainage terraces, letdown pipes, and associated erosion control features. All other runoff control structures will have been constructed prior to closure. Stormwater management structure locations and details are shown on **Drawings D13, D21, D22, D23, D24, and D25**. All earthwork will be performed in accordance with the CQA Plan, and all surface water control facilities will follow the procedures in the CQA Plan.

CQA Activities: Construction Quality Assurance (CQA) activities will be performed in accordance with the CQA Plan. CQA activities will include final cover barrier soil testing (field and laboratory), field geomembrane and geocomposite drainage layer installation inspection and testing, laboratory geomembrane and geocomposite drainage layer material testing, vegetative soil cover inspection and surveys, structure removal, and preparation of the CQA Acceptance Report.

Deed Notification: A notice of closure will be sent to the IEPA within 30 days after the date that the final volume of waste is received. Owner will record a notification on the deed to the Landfill property upon closure of all units. A copy of this instrument will be placed in the Operating Record. Owner will notify the IEPA that the notification has been recorded and a copy has been placed in the Operating Record. The notification will notify any potential purchaser of the property that the land has been used as a landfill facility and its use is restricted pursuant to 35 IAC Section 811.111(d).

The estimated schedule to perform the routine closure activities is provided in Exhibit 1 (Table 1-1). The schedule shows the total time required to close the site, and the time required for the various closure activities to allow tracking of the progress of closure. Closure activities will be initiated within 30 days of the date the unit receives the final receipt of waste and, assuming favorable conditions, will be completed within 180 days of beginning closure. An extension to the closure schedule will be requested pursuant to 35 IAC Section 811.110(f)(2), if necessary. Such an extension request will demonstrate that the closure will, by necessity, take longer than 180 days, and the Landfill and/or Owner has taken and will continue to take all necessary steps to prevent threats to human health and the environment from the unclosed portions of the Landfill.

2.2 Assumed Closure Date and Premature Closure

Premature closure is closure at the "assumed closure date," which is defined as "the point in time when the extent and manner of the facility's development…would make closure the most expensive" (35 IAC Section 811.700(e)). Premature closure assumes full development of the facility has not been completed and capacity has not been fully consumed.

In the event premature closure is required, the Owner will inspect the site conditions and review and modify the Closure Plan as needed to ensure that the site is closed in accordance with applicable requirements of 35 IAC Section 811 and 35 IAC Section 812. The primary site features to be reviewed and evaluated will include slope stability; stormwater drainage; gas monitoring, collection and control devices; final cover barrier soil material borrow area; final cover geomembrane and geocomposite drainage layer installation requirements; and protective cover material borrow source.

Anticipated steps necessary to prematurely close the Landfill are as described for routine closure in the previous section.

The estimated schedule to perform the premature closure activities is provided in Exhibit 1 (Table 1-2). The schedule shows the total time required to close the site and the time required for the various closure activities to allow tracking of the progress of closure. Closure activities will be initiated within 30 days of the date the unit receives the final receipt of waste and, assuming favorable conditions, will be completed within 180 days of beginning closure. An extension to the closure schedule will be requested pursuant to 35 IAC Section 811.110(f)(2), if necessary. In accordance with 35 IAC Section 811.110(e)(2), Owner will request an extension beyond the one-year deadline for closure if the MSWLF unit has remaining capacity to receive additional wastes and there is a reasonable likelihood that the MSWLF unit will receive additional wastes; such an extension must be granted by the IEPA if the MSWLF unit has remaining capacity to receive additional wastes and the Landfill and/or Owner has taken and will continue to take all necessary steps to prevent threats to human health and the environment from the unclosed portions of the Landfill.

2.3 Temporary Suspension of Waste

The Landfill does not intend to temporarily suspend waste acceptance at any time. If this does occur, however, the following minimum steps will be taken to protect human health and the environment:

- Verify that the minimum daily cover has been placed over all exposed waste. If temporary waste suspension is expected to, or will, occur longer than 60 days, place intermediate cover over all wastes that have not received final or intermediate cover;

- Secure the site, place a sign indicating the Landfill status notifying the public of the temporary suspension of waste acceptance;

- Verify that stormwater management controls are in place and operating correctly. Arrange for stormwater pumping if required;

- Inspect the site at least weekly and after each significant rainfall. Repair damaged cover promptly;

- Remove and dispose of any illegally-dumped waste on or adjacent to the Landfill;

- Maintain all groundwater, surface water, leachate, and LFG monitoring activities scheduled during the temporary suspension of waste; and

- Decontaminate any equipment leaving the site in accordance with the Closure Plan.

In the event that waste receipts are suspended, the Landfill will begin closure activities no later than one year after the most recent date that waste is received, unless an extension is requested from and granted by the IEPA.

2.4 Largest Area Requiring Final Cover

The existing landfill and proposed expansion will be operated such that contemporaneous operations and closure will occur throughout the life of the landfill. Final cover will be installed in stages in compliance with 35 IAC Section 811.314. The largest area requiring final cover during the life of the expanded Landfill will vary as development and closure occurs. At least once each year, the largest area requiring final cover is reviewed and identified based on site conditions. The area is then specified in the premature closure cost estimate, which is updated at least annually in accordance with the facility's IEPA permit (see Exhibit 2 for the premature closure cost estimate).

2.5 Maximum Inventory of Wastes

The maximum inventory of waste in storage at any time is summarized below:

- Landfill: the maximum inventory of waste disposed at the Landfill when it is fully developed will be approximately 30.9 million cubic yards.

- Leachate: the maximum volume of leachate that may be contained at the facility is currently equal to the capacity of the leachate storage tank(s); as of the date of this Plan, leachate storage tank capacity is approximately 229,000 gallons, including (2) 32,000 gallon tanks and one 165,000 gallon tank. The existing 165,000 gallon tank will be replaced and relocated to the northwest corner of the expansion footprint when development of the expansion begins. The maximum volume of leachate storage for the expansion will be equal to the cumulative storage of the installed tanks, which will be at least 229,000 gallons.

3.0 POST-CLOSURE CARE PLAN (812.115)

The Owner will monitor and maintain the expanded Landfill for a minimum period of 30 years following closure. **Drawings D11, D12, and D14** are provided to show the final grades, structures, and monitoring devices to remain during the post-closure care period. As previously noted, the landfill will be closed incrementally and settlement is anticipated to occur after closure. Therefore, the final topography may vary from the topography shown to allow each area being closed to tie into adjacent closed areas.

All wastes and waste residues will be treated, removed from the site, or disposed at a properly permitted facility within 30 days after receipt of the final volume of waste. All equipment and structures not necessary for the post-closure land use will also be removed. This will include removing the scales and Landfill operations equipment not necessary for post-closure maintenance activities. If appropriate, the office building, maintenance building, landfill gas collection and control equipment, and leachate loadout and storage area may remain onsite to facilitate post-closure care, at the discretion of the Owner.

The proposed end use of the site will be a natural area of passive open space. The post-closure use of the site will not disturb the integrity of the final cover, liner, any other components of the containment system, or the function of the monitoring systems. The Owner will submit the appropriate applications to the IEPA if it decides to pursue any other land use or any disturbance at the site. Any approved disturbance at the site will demonstrate that the integrity of the final cover, liner, or other component of the containment system, including any removal of waste, will not increase the potential threat to human health or the environment. Any other use is subject to IEPA approval.

3.1 Maintenance and Inspections

The Owner will conduct a visual inspection of all vegetated surfaces for a minimum period of 30 years after closure, or as otherwise approved by the IEPA. Inspections will be conducted quarterly during the first 5 years following closure, and annually thereafter.

The following features shall be inspected:

- Landfill cover for rills, gullies, and crevices;
- Vegetation for evidence of failure or damage, such as due to erosion or LFG stress;
- Existing woodlands and proposed landscaping and trees for evidence of damage, such as due to erosion or storm damage;
- Evidence of excessive landfill settlement, such as standing water, cracks, poor drainage, depressions, holes, etc.
- Landfill gas extraction well alignments for readjustments as necessary;
- Drainage channel erosion and scour;
- Culverts for crushing, clogging, and excessive corrosion;

- Stormwater detention basins for vegetation, erosion, sedimentation / need for dredging, etc.; and

- Site boundary fence, gates, and locks for evidence of damage and disrepair.

Features will be maintained in accordance with the following specifications:

- All rills, gullies and crevices 6 inches or deeper that are identified will be filled. Desiccation cracking of soil that normally occurs during extremely dry weather does not warrant corrective actions provided the desiccation cracks heal during wet weather.

- All eroded and scoured drainage channels will be repaired, and lining material will be replaced as necessary. Areas identified as particularly susceptible to erosion will be re-graded as necessary to minimize such susceptibility.

- As required by the conditions of the Siting Ordinance, existing woodlands and proposed landscaping and trees planned as part of the Site 2 North Expansion will be maintained and replaced as necessary.

- All holes and depressions created by settling will be filled and re-contoured to prevent standing water.

- Stormwater culverts and basins shall be maintained to pass the design stormwater runoff. This may require removing debris buildup at culvert entrances, remove excessive sediment buildup, and/or reline or replace culverts that have failed structurally.

- All re-worked surfaces, and areas with failed or eroded vegetation in excess of 100 square feet cumulatively, will be re-vegetated in accordance with the approved Closure Plan.

- The final cover will be mowed annually to prevent trees, brush, shrubs, and other deep-rooted vegetation from becoming established.

- Site boundary fencing, gates, and locks will be repaired as required to maintain site security.

3.2 Leachate Collection and Management System Operation and Monitoring

The Landfill will collect and manage leachate for a minimum of 30 years after closure, or as otherwise approved by the IEPA. Operating and maintaining the leachate management system will include the following primary tasks:

- Maintaining the air compressor used to supply the air for the pneumatic leachate removal pumps (if used). Routine air compressor maintenance typically consists of changing oil and belts, and draining condensed water in the compressed air reservoir tank. Routine maintenance will be conducted in accordance with the procedures and schedules recommended by the air compressor manufacturer.

- Maintaining the leachate collection pumps and leachate transfer pump to ensure efficient operation. Maintenance generally consists of removing any excessive build-up of scale. Routine maintenance will be conducted in accordance with the procedures and schedules recommended by the pump manufacturer and as otherwise required.

- Maintaining the leachate flow meters. Routine maintenance and inspection will be conducted in accordance with procedures and schedules recommended by the flow meter manufacturer and as otherwise required.

- Cleaning leachate collection piping as necessary to remove sediment and to open clogged perforations. Leachate pipe cleanout will consist of injecting water at high pressure into the leachate collection piping. Access to the piping will be provided by the leachate collection pipe cleanouts.

- Discharging collected stormwater from the leachate storage tank secondary containment on an as-needed basis in order to maintain the necessary secondary containment volume. Stormwater will be inspected for evidence of contamination by leachate prior to discharge. If contaminated, the stormwater will be disposed as leachate. Otherwise, collected stormwater will be discharged.

Leachate extracted during the post-closure care period will continue to be transported offsite to a properly permitted wastewater treatment facility for treatment and disposal. Representative samples of leachate will be collected from the leachate collection wells/sumps as required by the Landfill's IEPA permit. Parameters to be monitored and sampling frequency will be in accordance with current regulations specified in 35 IAC Section 811.309(g).

3.3 Gas Monitoring, Collection and Control

Landfill gas monitoring will be performed in accordance with current regulations specified in 35 IAC Section 811.310(a)-(d) and the Landfill's IEPA permit throughout the 30-year post-closure care period. The required monitoring period may be reduced by the IEPA upon a demonstration that the reduced period is sufficient to protect human health and the environment. Details of the landfill gas monitoring activities are provided in the Environmental Monitoring Plan. Landfill gas monitoring locations are illustrated on **Drawing D14**.

Landfill gas will be collected and controlled throughout the post-closure care period as required to meet the standards specified in 35 IAC Section 811.311(d)(11). The landfill gas collection and control system is designed to function for the entire design period, and includes provisions to allow the system to accommodate changing gas flow rates or composition. The landfill gas collection and control system is shown on **Drawing D14**, with system details shown on **Drawings D26 and 27**.

The landfill gas collection and control system will be operated and maintained to ensure the landfill gas is managed in accordance with IEPA regulations. These activities will include routine monitoring of the gas extraction wellheads for vacuum and gas quality, adjusting wellhead and header valves to ensure that the collection system is balanced, and maintaining the mechanical components of the system (e.g. blowers, valves, flares, etc.).

3.4 Groundwater Monitoring

Groundwater monitoring will be performed in accordance with the Landfill's IEPA permit throughout the 30-year post-closure care period. The required monitoring period may be reduced by the IEPA upon a demonstration that the reduced period is sufficient to protect human health and the environment. Groundwater monitoring activities are detailed in the Environmental Monitoring Plan. Groundwater monitoring locations are illustrated on **Drawing D12**.

3.5 Security

Fencing, gates and other required security measures will be inspected and maintained during the post-closure period to prevent any unauthorized access to the Landfill.

3.6 Recordkeeping

All inspection records, data, corrective action records, leachate monitoring data, landfill gas monitoring data, groundwater monitoring data, surface monitoring data, etc. will be maintained with the Operating Record. A copy of the Post-Closure Care Plan will also be made part of the Operating Record.

3.7 Evaluation of Data Collected During Post-Closure Care Period

The Landfill is responsible for ensuring that all data collected in accordance with this Plan is properly reviewed, evaluated, and acted upon.

All groundwater, landfill gas, and leachate monitoring data and inspection records will be reviewed by the Landfill and/or Owner or other designated authority as the data becomes available. Data review will consist of conducting the required statistical analyses (groundwater data) and comparing the results to the established standards. Any deviations from the standards will be reported to the IEPA as required. Any deviations requiring corrective actions will be promptly corrected.

All inspection reports, monitoring data, and reports on corrective actions will be reviewed as necessary for certification of closure. This review will ensure that the collected data are checked and that all required corrective actions are properly implemented.

4.0 CLOSURE AND POST-CLOSURE CARE COST ESTIMATES (812.116)

4.1 Cost Estimates

Closure and post-closure care cost estimates have been prepared in accordance with the applicable requirements of 35 IAC Section 811. The closure cost estimate includes the following itemized costs: 1) the cost of applying final cover to the closure area; 2) the cost to complete landfill gas monitoring and collection systems; 3) the cost to complete runoff control structures; and, 4) the cost of certification of closure. The closure cost estimate assumes that closure is initiated on the assumed closure date, under a premature closure condition. Premature closure costs will change as site development progresses, as they are dependent on the acreage of the currently active phase and the number of former phases that have already been closed. In accordance with the existing facility's IEPA permit, premature closure costs are updated annually and when necessary as modifications to the permit are proposed, and this practice will continue for the expanded Landfill. The premature closure cost estimate is therefore based on the current site status as development progresses. The most recent estimate of the cost of premature final closure is contained in Exhibit 2 (Table 1).

The post-closure care cost estimate includes the itemized costs of carrying out all of the activities described in the Post-Closure Care Plan. The post-closure care cost estimate is based on currently permitted groundwater monitoring frequencies and assumes leachate and landfill gas collection will continue throughout the 30-year post-closure period. The most recent estimate of the cost of post-closure care is contained in Exhibit 2 (Table 2).

The cost estimates have not been reduced by any allowance for the salvage value of equipment or the resale value of land or landfill gas, nor has a discount rate been applied. They reflect current third party costs, and assume the IEPA will contract for all closure and post-closure care work. Cost estimates will be revised annually as development progresses and whenever a change in the cost estimates occur or the Closure Plan or Post-Closure Care Plan is modified.

4.2 Financial Assurance

Financial assurance will be provided in accordance with IEPA regulations to ensure that sufficient funds are available to complete Landfill closure and post-closure care. The amount of financial assurance that is required at any time is based on the Landfill area which has been granted operating authorization and, of that area, how much final cover and other closure work remains to be completed and approved by the IEPA. The IEPA reviews and must approve all cost estimates prior to issuing operating authorization for new Landfill cells.

EXHIBIT 1

ROUTINE AND PREMATURE CLOSURE SCHEDULES

TABLE 1-1
ESTIMATED TIME REQUIRED FOR ROUTINE CLOSURE (MONTHS)

Task	Month 1	Month 2	Month 3	Month 4	Month 5	Month 6
1. Notify Agency						
2. Equipment Decontamination						
3. Low Permeability Cover (24 inches)						
4. Geomembrane and Geocomposite Drainage Layer Placement						
5. Protective Cover (36 inches)						
6. LFG Probes / Wells / Piping System						
7. Grading						
8. Vegetation						
9. Certification of Closure						

Note: Estimated times assume favorable weather conditions

TABLE 1-2
ESTIMATED TIME REQUIRED FOR PREMATURE CLOSURE (MONTHS)

Task	Month 1	Month 2	Month 3	Month 4	Month 5	Month 6
1. Agency Determination that Premature Closure is Necessary						
2. Equipment Decontamination						
3. Backfilling of Excavated Cell						
4. Low Permeability Cover (24 inches)						
5. Geomembrane and Geocomposite Drainage Layer Placement						
6. Protective Cover (36 inches)						
7. LFG Probes / Wells / Piping System						
8. Grading						
9. Vegetation						
10. Certification of Closure						

Note: Estimated times assume favorable weather conditions.

EXHIBIT 2

CLOSURE AND POST-CLOSURE CARE COST ESTIMATES

Table 1
Premature Closure Cost Estimate*
Zion Landfill

Premature Closure Cost Estimate[1]				
Item	Unit	Quantity	Unit Cost	Total
Mobilizations	LS	1	$56,003	$56,003
Clay Cover	CY	225,544	$5.67	$1,278,834
Geomembrane	SF	3,044,844	$0.425	$1,294,059
Geocomposite	SF	3,044,844	$0.418	$1,272,745
Protective Soil	CY	281,930	$4.99	$1,406,831
Topsoil	CY	56,386	$6.29	$354,668
Surface Water Management:				
Miscellaneous Structures	Lin ft.	1,357	$239.80	$325,409
Miscellaneous Grading/Installations	LS	1	$27,350	$27,350
Seeding	Acre	69.90	$1,510	$105,549
Gas Wells	Lin ft.	3,282	$106.98	$351,108
Gas Laterals	Lin ft.	9,142	$35.24	$322,164
CQA	Acre	69.90	$12,585	$879,692
Certification of Closure	LS	1.00	$5,000	$5,000
Total (2021 Dollars)				**$7,679,412**

Note

1.) The 2020 premature closure cost estimate provided for final cover construction and landfill gas collection system installation over 60.8-acres of unclosed airspace through cells 10a and 10b. The site will construct 9.1-acres of cell 10c in 2021 and the premature closure cost estimate accounts for this new airspace. The 2021 premature closure cost estimate thus provides for final cover construction over 69.9-acres.

** Premature closure quantities, unit costs, and cost estimate from IEPA Log #2021-271 addressing permit condition X.6 and providing the annual update of the premature closure, decommissioning, and post-closure care cost estimates for the Zion Lnadfill. Premature closure costs will continue to be updated to reflect current and proposed development and closure needs on an annual basis, including incorporation of the proposed Site 2 North Expansion as it is permitted and constructed.*

Table 2

Post-Closure Care Cost Estimate*

Zion Landfill Post-Closure Care Cost Estimate for Area to be filled through 2022				
Item	Unit	Quantity	Unit Cost	Annual Cost
Inspections	Each	4	$897	$3,588
Monitoring				
15 Quarterly Groundwater Wells				
Sampling	Samples	60	157.27	$9,436
List G1	Samples	30	$132.50	$3,975
List G1 and G2	Samples	30	$327.50	$9,825
35 Semi-Annual Groundwater Wells				
Semi-Annual Sampling	Samples	70	157.27	$11,009
List G1 and G2	Samples	70	$327.50	$22,925
Gas				
Probes	Hour	4	$49.03	$196
Quarterly Surface Scan	Each	4	$2,800	$11,200
Leachate				
Sampling	Each	2	150.87	$302
Leachate Level Measurements	Each	32	$24	$768
List L2	Each	1	$1,702.50	$1,703
Lists L2 and L3	Each	1	$1,797.50	$1,798
Storm Water	Each	12	$1,390	$16,680
Maintenance				
Final Cover	Hour	60	$282.72	$16,963
Vegetation Repair	Acre	3	$1,697	$5,091
Mowing	Acre	158	$56.00	$8,848
Leachate System	LS	1	$16,801	$16,801
Miscellaneous Repairs	LS	1	$26,396	$26,396
Gas Extraction System	LS	1	$4,154	$4,154
Landscaping Maintenance and Replacement	LS	1	$50,000	$50,000
Operation				
Leachate Disposal	Gallons	1,500,000	$0.0990	$148,500
Gas/Leachate Extraction System	LS	1	$24,542	$24,542
Sedimentation Basin Cleaning	LS	1	$9,439	$9,439
Leachate System Cleaning	LS	0.25	$4,908	$1,227
Snow Removal	LS	1	$11,201	$11,201
Reporting /Record Keeping	LS	1	$21,077	$21,077
Total Annual Cost (2021 Dollars)				$437,644

Decommissioning Costs		
Well and Probe Decomissioning	76 wells and perimeter probes x $703/well =	$53,428
Gas System Decommissioning	Estimated Lump Sum =	$283,793
Total Decommissioning Cost (2020 Dollars)		$337,221

Leachate Storage Tank Maintenance Costs		
Item	Unit	
Inspecting & Cleaning (one 165,000 gal. & two 32,000 gal., based on a frequency of once every ten years of service, approximately 3 times during the 30 year period)	Estimated Lump Sum =	$63,347
Exterior Painting (one 165,000 gal & two 32,000 gal., based on a frequency of once every fifteen years of service, approximately 2 times during the 30 year period)	Estimated Lump Sum =	$23,462
Interior Coating (one 165,000 gal & two 32,000 gal., based on a frequency of once every fifteen years of service, approximately 2 times during the 30 year period)	Estimated Lump Sum =	$46,924
Total Leachate Storage Tank Maintenance Cost (2021 Dollars)		$133,733

* Post-closure care quantities, unit costs, and cost estimate from IEPA Log #2021-271. Post-closure care costs will continue to be updated on an annual basis, including incorporation of the proposed Site 2 North Expansion as it is permitted and constructed.

Table 3
Summary of Required Financial Assurance*
Zion Landfill

Premature Closure		
Total Closure (2020 Dollars)	$	7,679,412

Decomissioning		
Total Decommissioning (2020 Dollars)	$	337,221

Leachate Storage Tank Maintenance		
Total Leachate Storage Tank Maintenance (2020 Dollars)	$	133,733

Post-Closure Care				
Component	Unit Cost	Unit	Quantity	Cost
Total Post-Closure Care (2020 Dollars)	$ 437,644	Lump Sum	30	$ 13,129,320

Total = (2020 Dollars)	$	21,279,686

* Summary of required financial assurance from IEPA Log #2021-271. The financial assurance summary will continue to be updated on an annual basis, including incorporation of the proposed Site 2 North Expansion as it is permitted and constructed.

ATTACHMENT 8
Site 2 East Expansion Base Liner System
CQA Summary Tables

TABLE 5

SUMMARY OF LABORATORY TEST RESULTS FOR CLAY LINER MATERIAL (SOURCE)

ZION LANDFILL SITE 2 EAST EXPANSION - CELL 9 COMPOSITE LINER

DECEMBER 2015

ASTM No.			D422		D4318			D2216	D1557		D5084	D2487
			Grain Size Analysis		Atterberg Limits			Sampled Water	Modified Proctor Density		Coefficient	
Date Sampled	Sample Number	Sample Location	%Fines <#200	%Clay <.002	Liquid Limit	Plastic Limit	Plasticity Index	Content (%)	Max. Dry Density (pcf)	Optimum Water (%)	Permeability (cm/sec)	U.S.C.S.
5/8/15	ZN-CS-1	Borrow Source	76.6	34.5	27.0	14.6	12.4	12.3	130.0	9.0	9.0×10^{-8}	CL
5/8/15	ZN-CS-2	Borrow Source	86.4	28.0	29.1	15.6	13.5	15.0	131.9	9.1		CL
7/27/15	ZN-CS-3	Borrow Source	80.2	29.0	25.0	14.9	11.1	15.8	131.8	9.2		CL
7/27/15	ZN-CS-4	Borrow Source	82.7	30.5	25.4	15.1	10.3	16.0	130.0	9.1		CL
8/14/15	ZN-CS-5	Borrow Source	92.1	29.0	31.5	17.2	14.3	16.7	123.8	11.5		CL
8/14/15	ZN-CS-6	Borrow Source	75.7	18.5	22.7	14.1	8.6	13.4	125.7	10.4		CL/CL-ML
8/15/15	ZN-CS-7	Borrow Source	85.1	36.0	27.1	14.2	12.9	15.4	128.8	9.4		CL
8/21/15	ZN-CS-8	Borrow Source	83.3	34.0	27.8	13.4	14.4	15.4	128.4	9.8		CL
8/24/15	ZN-CS-9	Borrow Source	79.7	26.0	20.9	12.3	8.6	10.4	132.8	8.0		CL/CL-ML
8/27/15	ZN-CS-10	Borrow Source	87.9	31.5	28.9	13.8	15.1	13.6	130.8	8.4		CL
8/27/15	ZN-CS-11	Borrow Source	78.5	32.5	26.5	13.0	13.5	13.6	131.1	9.1		CL
8/28/15	ZN-CS-12	Borrow Source	82.0	33.5	25.1	12.4	12.7	14.4	131.2	9.4		CL
9/3/15	ZN-CS-13	Borrow Source	82.9	27.5	26.1	12.1	14.0	15.4	130.0	9.2		CL
9/4/15	ZN-CS-14	Borrow Source	80.4	25.0	24.8	11.2	13.6	13.7	130.3	9.0		CL
9/5/15	ZN-CS-15	Borrow Source	69.4	17.0	18.3	11.1	7.2	11.8	130.7	9.2		CL/CL-ML

TABLE 5

SUMMARY OF LABORATORY TEST RESULTS FOR CLAY LINER MATERIAL (SOURCE)

ZION LANDFILL
SITE 2 EAST EXPANSION - CELL 9 COMPOSITE LINER

DECEMBER 2015

ASTM No.			D422		D4318			D2216	D1557		D5084	D2487
			Grain Size Analysis		Atterberg Limits			Sampled Water	Modified Proctor Density		Coefficient	
Date Sampled	Sample Number	Sample Location	%Fines <#200	%Clay <.002	Liquid Limit	Plastic Limit	Plasticity Index	Content (%)	Max. Dry Density (pcf)	Optimum Water (%)	Permeability (cm/sec)	U.S.C.S.
9/16/15	ZN-CS-16	Borrow Source	83.9	41.5	27.3	13.2	14.1	14.4	128.4	10.0		CL
9/17/15	ZN-CS-17	Borrow Source	83.6	47.0	29.2	13.7	15.5	12.3	130.1	9.0		CL
9/17/15	ZN-CS-18	Borrow Source	80.0	28.5	26.5	12.6	13.9	11.3	128.7	11.0		CL
9/23/15	ZN-CS-19	Borrow Source	84.5	42.0	27.5	13.3	14.2	15.3	128.3	11.1		CL
9/23/15	ZN-CS-20	Borrow Source	84.1	39.5	26.9	14.1	12.8	16.7	128.4	9.6		CL
9/24/15	ZN-CS-21	Borrow Source	81.5	40.0	25.7	12.9	12.8	16.0	129.9	9.6		CL
9/24/15	ZN-CS-22	Borrow Source	86.0	44.0	27.6	13.8	13.8	17.2	127.9	10.0		CL
Minimum:			**69.4**	**17.0**	**18.3**	**11.1**	**7.2**	**10.4**	**123.8**	**8.0**		
Maximum:			**92.1**	**47.0**	**31.5**	**17.2**	**15.5**	**17.2**	**132.8**	**11.5**		
Average:			**82.1**	**32.5**	**26.2**	**13.6**	**12.7**	**14.4**	**129.5**	**9.6**	**9.0×10^{-8}**	
Project Requirements:			**$\geq$50.0**				**$\geq$4.0**				**$\leq 1.0 \times 10^{-7}$**	**CL,CH, CL-ML**

Note: 1. Prior to Liner construction of Cell 9, the Zion landfill began the 2015 Final Closure on April 29, 2015. The selected borrow source sample was obtained on May 11, 2015 (Sample No. ZN-CS-3), with a maximum dry density of 130.5 pcf at optimum moisture content of 9.8 percent. This laboratory test result is provided in Appendix "G."

TABLE 7

SUMMARY OF LABORATORY TEST RESULTS FOR
CLAY LINER MATERIAL (IN-PLACE)

ZION LANDFILL
SITE 2 EAST EXPANSION - CELL 9 COMPOSITE LINER

DECEMBER 2015

ASTM No.					D422		D4318			D2937	D2216	D5084	D2487	D2216
					Grain Size Analysis		Atterberg Limits			Dry	Water	Coefficient		Sampled
Date	Sample	Lift	Coordinates		%Fines	%Clay	Liquid	Plastic	Plasticity	Density	Content	Permeability		Water
Sampled	Number	No.	North	East	<#200	<.002	Limit	Limit	Index	(pcf)	(%)	(cm/sec)	U.S.C.S.	Content
9/4/15	ZN-CL-1	1	12250	12550	85.4	29.0	24.6	12.7	11.9	124.6	13.0	9.1×10^{-8}	CL	9.4
9/30/15	ZN-CL-2	1	11650	12850	79.3	32.5	28.0	13.2	14.8	125.8	15.8		CL	14.5
8/28/15	ZN-CL-3	2	12200	12700	77.5	30.0	26.6	13.4	13.2	127.2	13.9		CL	15.5
9/14/15	ZN-CL-4	2	11800	12600	83.1	44.0	23.6	12.4	11.2	127.6	13.1	2.2×10^{-8}	CL	9.3
8/17/15	ZN-CL-5	3	12350	12850	81.1	27.0	21.5	12.3	9.2	125.7	12.6		CL	12.1
9/3/15	ZN-CL-6	3	12050	12453	85.5	36.0	28.8	13.7	15.1	123.7	14.1		CL	14.8
10/5/15	ZN-CL-7	3	11650	12350	80.0	35.0	26.7	12.8	13.9	122.2	14.1	8.3×10^{-8}	CL	13.9
8/17/15	ZN-CL-8	4	12100	12900	73.3	26.0	22.4	11.9	10.5	127.7	13.2	8.7×10^{-8}	CL	10.8
9/28/15	ZN-CL-9	4	11800	12700	80.8	33.5	28.3	13.5	14.8	123.1	15.7		CL	14.0
9/14/15	ZN-CL-10	5	12150	12450	82.1	49.5	26.7	12.6	14.1	121.6	15.4		CL	15.9
9/2/15	ZN-CL-11	5	11550	12950	82.7	31.0	27.9	13.5	14.4	119.8	15.6	7.1×10^{-8}	CL	13.9
9/2/15	ZN-CL-12	6	12000	12900	72.5	23.5	22.7	12.4	10.3	125.2	12.7	9.1×10^{-8}	CL	12.1
10/7/15	ZN-CL-13	6	11600	12200	73.4	20.5	21.2	12.7	8.5	122.3	13.2		CL	13.2
9/4/15	ZN-CL-14	7	12150	12950	83.7	35.0	27.0	13.4	13.6	124.3	12.3		CL	14.5
9/28/15	ZN-CL-15	7	11650	12650	77.9	26.0	23.7	12.5	11.2	128.7	13.9	8.6×10^{-8}	CL	13.8

TABLE 7

SUMMARY OF LABORATORY TEST RESULTS FOR
CLAY LINER MATERIAL (IN-PLACE)

ZION LANDFILL
SITE 2 EAST EXPANSION - CELL 9 COMPOSITE LINER

DECEMBER 2015

ASTM No.					D422		D4318			D2937	D2216	D5084	D2487	D2216
					Grain Size Analysis		Atterberg Limits			Dry	Water	Coefficient		Sampled
Date	Sample	Lift	Coordinates		%Fines	%Clay	Liquid	Plastic	Plasticity	Density	Content	Permeability		Water
Sampled	Number	No.	North	East	<#200	<.002	Limit	Limit	Index	(pcf)	(%)	(cm/sec)	U.S.C.S.	Content
9/4/15	ZN-CL-16	8	12400	12600	84.6	28.0	26.9	13.0	13.9	122.4	14.4	8.3×10^{-8}	CL	12.3
9/17/15	ZN-CL-17	8	11900	12700	82.5	44.0	26.8	13.0	13.8	125.6	12.9		CL	13.0
10/5/15	ZN-CL-18	8	11522	12700	82.0	39.0	26.7	13.2	13.5	119.5	14.8	8.9×10^{-8}	CL	15.3
9/28/15	ZN-CL-19	9	12050	12750	81.1	29.0	26.8	13.3	13.5	129.0	13.4		CL	11.5
10/1/15	ZN-CL-20	9	11550	12950	80.4	29.5	27.1	13.2	13.9	125.4	14.9	5.6×10^{-8}	CL	12.9
9/28/15	ZN-CL-21	10	12000	12900	82.2	32.5	28.1	13.9	14.2	125.0	12.7	9.1×10^{-8}	CL	12.6
10/7/15	ZN-CL-22	10	11600	12400	74.5	19.5	20.9	12.9	8.0	123.7	14.3		CL	12.5
Minimum:					**72.5**	**19.5**	**20.9**	**11.9**	**8.0**	**119.5**	**12.3**	**2.2×10^{-8}**		**9.3**
Maximum:					**85.5**	**49.5**	**28.8**	**13.9**	**15.1**	**129.0**	**15.8**	**9.1×10^{-8}**		**15.9**
Average:					**80.3**	**31.8**	**25.6**	**13.0**	**12.6**	**124.5**	**13.9**	**7.9×10^{-8}**	**CL**	**13.1**
Project Requirements:					**$\geq$50.0**				**$\geq$4.0**			**$\leq 1.0 \times 10^{-7}$**	**CL, CH, CL-ML**	

TABLE 4

SUMMARY OF LABORATORY TEST RESULTS FOR CLAY LINER MATERIAL (BORROW SOURCE)

ZION LANDFILL
CELL 10 A/B COMPOSITE LINER

JANUARY 2020

ASTM No.			D6913/D7928		D4318			D2216	D1557		D5084	D2487
			Grain Size Analysis		Atterberg Limits			Sampled Water Content	Modified Proctor Density		Coefficient Permeability	
Date Sampled	Sample Number	Sample Location	%Fines <#200	%Clay <.002	Liquid Limit	Plastic Limit	Plasticity Index	(%)	Max. Dry Density (pcf)	Optimum Water (%)	(cm/sec)	U.S.C.S.
12/4/19	ZN-CS-1	Borrow Source	89.3	35.0	27.6	14.3	13.3	16.3	131.0	9.7	6.2×10^{-8}	CL
7/2/19	ZN-CS-2	Borrow Source	79.6	20.5	20.4	12.5	7.9	12.2	132.4	8.4		CL
7/2/19	ZN-CS-3	Borrow Source	85.0	34.5	26.4	13.1	13.3	12.5	130.6	8.6		CL
7/2/19	ZN-CS-4	Borrow Source	83.0	33.0	29.4	13.6	15.8	15.5	128.0	9.7		CL
7/12/19	ZN-CS-5	Borrow Source	85.3	36.5	27.4	13.9	13.5	16.9	126.5	9.5		CL
7/12/19	ZN-CS-6	Borrow Source	84.8	40.0	29.5	14.3	15.2	16.1	125.0	10.5		CL
8/1/19	ZN-CS-7	Borrow Source	85.6	37.5	28.9	14.2	14.7	17.6	130.3	9.6		CL
8/1/19	ZN-CS-8	Borrow Source	84.5	34.5	27.5	13.7	13.8	15.5	131.4	8.9		CL
8/9/19	ZN-CS-9	Borrow Source	81.1	36.5	27.5	14.6	12.9	14.4	130.4	9.9		CL
8/9/19	ZN-CS-10	Borrow Source	82.4	33.0	29.5	14.6	14.9	15.6	128.0	10.2		CL
8/24/19	ZN-CS-11	Borrow Source	87.1	34.0	29.4	14.3	15.1	15.4	129.0	10.6		CL
8/24/19	ZN-CS-12	Borrow Source	84.1	35.0	27.0	13.5	13.5	15.2	126.8	10.5		CL
8/24/19	ZN-CS-13	Borrow Source	82.7	34.5	28.7	13.7	15.0	16.2	128.5	9.6		CL
9/5/19	ZN-CS-14	Borrow Source	85.2	36.5	29.0	13.8	15.2	15.5	129.8	9.1		CL
9/5/19	ZN-CS-15	Borrow Source	85.2	33.0	30.1	14.2	15.9	15.9	130.9	9.3		CL

TABLE 4

SUMMARY OF LABORATORY TEST RESULTS FOR CLAY LINER MATERIAL (BORROW SOURCE)

ZION LANDFILL
CELL 10 A/B COMPOSITE LINER

JANUARY 2020

ASTM No.			D6913/D7928		D4318			D2216	D1557		D5084	D2487
			Grain Size Analysis		Atterberg Limits			Sampled Water	Modified Proctor Density		Coefficient	
Date Sampled	Sample Number	Sample Location	%Fines <#200	%Clay <.002	Liquid Limit	Plastic Limit	Plasticity Index	Content (%)	Max. Dry Density (pcf)	Optimum Water (%)	Permeability (cm/sec)	U.S.C.S.
12/4/19	ZN-CS-16	Borrow Source	81.8	36.0	32.9	15.4	17.5	15.8	127.7	10.9		CL
12/5/19	ZN-CS-17	Borrow Source	98.4	54.5	44.3	18.7	25.6	21.8	119.0	12.2		CL
Minimum:			**79.6**	**20.5**	**20.4**	**12.5**	**7.9**	**12.2**	**119.0**	**8.4**		
Maximum:			**98.4**	**54.5**	**44.3**	**18.7**	**25.6**	**21.8**	**132.4**	**12.2**		
Average:			**85.0**	**35.6**	**29.1**	**14.3**	**14.9**	**15.8**	**128.5**	**9.8**	**6.2×10^{-8}**	**CL**
Project Requirements:			**$\geq$50.0**				**$\geq$4.0**				**$\leq 1.0 \times 10^{-7}$**	**CL/CH CL-ML**

TABLE 6

SUMMARY OF LABORATORY TEST RESULTS FOR CLAY LINER MATERIAL (IN-PLACE)

ZION LANDFILL PHASE 10 A/B COMPOSITE LINER

JANUARY 2020

ASTM No.					D6913/D7928		D4318			D2937	D2216	D5084	D2487	D2216
					Grain Size Analysis		Atterberg Limits			Dry	Water	Coefficient		Sampled
Date	Sample	Lift	Coordinates		%Fines	%Clay	Liquid	Plastic	Plasticity	Density	Content	Permeability		Water
Sampled	Number	No.	North	East	<#200	<.002	Limit	Limit	Index	(pcf)	(%)	(cm/sec)	U.S.C.S.	Content
10/8/19	ZN-CL-1	1	11350	12750	77.4	33.5	26.2	12.3	13.9	125.5	13.9	7.9×10^{-8}	CL	13.1
11/9/19	ZN-CL-2	2	11500	13000	79.4	29.5	24.0	12.6	11.4	125.6	12.4		CL	13.7
7/30/19	ZN-CL-3	2	11300	12300	68.0	28.5	24.2	12.6	11.6	125.8	11.8	8.3×10^{-8}	CL	10.0
8/31/19	ZN-CL-4	3	11450	12550	86.9	27.5	22.8	12.3	10.5	125.9	12.1	8.7×10^{-8}	CL	12.6
7/12/19	ZN-CL-5	4	11500	11900	84.6	26.5	21.7	12.6	9.1	128.2	13.0	2.7×10^{-8}	CL	12.3
8/14/19	ZN-CL-6	4	11300	12600	83.1	27.0	26.3	12.9	13.4	124.1	13.5		CL	12.6
7/30/19	ZN-CL-7	5	11250	12150	72.8	29.0	24.9	12.9	12.0	128.3	11.8	5.1×10^{-8}	CL	11.8
7/15/19	ZN-CL-8	6	11400	12100	85.5	34.0	27.1	13.2	13.9	121.1	15.8	9.2×10^{-8}	CL	13.0
10/9/19	ZN-CL-9	6	11200	12700	83.2	35.0	26.2	12.4	13.8	123.6	14.1		CL	13.9
8/9/19	ZN-CL-10	7	11250	12450	86.6	36.0	28.6	14.4	14.2	124.9	13.8	2.4×10^{-8}	CL	15.7
8/31/19	ZN-CL-11	8	11500	12300	84.8	37.0	29.2	13.6	15.6	126.1	12.6		CL	13.1
12/11/19	ZN-CL-12	8	11300	12900	82.5	30.5	24.7	14.9	9.8	116.4	14.2	9.0×10^{-8}	CL	13.7
8/3/19	ZN-CL-13	9	11250	12150	85.8	35.5	27.9	13.4	14.5	130.8	11.9	3.5×10^{-8}	CL	13.4
9/25/19	ZN-CL-14	10	11500	12600	80.2	35.0	25.6	12.3	13.3	120.5	15.8		CL	10.9
9/25/19	ZN-CL-15	10	11300	11900	84.0	29.5	25.8	13.3	12.5	124.4	12.2	4.2×10^{-8}	CL	10.4

TABLE 6

SUMMARY OF LABORATORY TEST RESULTS FOR CLAY LINER MATERIAL (IN-PLACE)

ZION LANDFILL
PHASE 10 A/B COMPOSITE LINER

JANUARY 2020

ASTM No.					D6913/D7928		D4318			D2937	D2216	D5084	D2487	D2216
					Grain Size Analysis		Atterberg Limits			Dry	Water	Coefficient		Sampled
Date Sampled	Sample Number	Lift No.	Coordinates North	Coordinates East	%Fines <#200	%Clay <.002	Liquid Limit	Plastic Limit	Plasticity Index	Density (pcf)	Content (%)	Permeability (cm/sec)	U.S.C.S.	Water Content
1/9/20	ZN-CLV-1*	10	11244	12138	-	-	-	-	-	127.8	12.6	3.1×10^{-8}		
Minimum:					**68.0**	**26.5**	**21.7**	**12.3**	**9.1**	**116.4**	**11.8**	2.4×10^{-8}		**10.0**
Maximum:					**86.9**	**37.0**	**29.2**	**14.9**	**15.6**	**130.8**	**15.8**	9.2×10^{-8}		**15.7**
Average:					**81.7**	**31.6**	**25.7**	**13.0**	**12.6**	**124.9**	**13.2**	5.8×10^{-8}	**CL**	**12.7**
Project Requirements:					$\geq$**50.0**				$\geq$**4.0**			$\leq 1.0 \times 10^{-7}$	**CL/CH**	

*Sample collected to verify permeability and density from frost exposure.

TABLE 4

SUMMARY OF LABORATORY TEST RESULTS FOR CLAY LINER MATERIAL SAMPLED FROM THE BORROW SOURCE

ZION LANDFILL CELL 10C COMPOSITE LINER

NOVEMBER 2021

ASTM No.			D6913/D7928		D4318			D2216	D1557		D5084	D2487
			Grain Size Analysis		Atterberg Limits			Sampled Water	Modified Proctor Density		Coefficient	
Date Sampled	Sample Number	Sample Location	%Fines <#200	%Clay <.002	Liquid Limit	Plastic Limit	Plasticity Index	Content (%)	Max. Dry Density (pcf)	Optimum Water (%)	Permeability (cm/sec)	U.S.C.S.
6/1/21	ZN-CS-1	Borrow Source	84.4	35.5	22	14	8	14.7	127.1	10.6	5.8×10^{-8}	CL
7/7/21	ZN-CS-2	Borrow Source	83.9	33.9	28	13	15	14.5	126.7	11.5		CL
7/7/21	ZN-CS-3	Borrow Source	73.0	27.2	27	13	14	16.0	129.1	10.8		CL
7/13/21	ZN-CS-4	Borrow Source	82.1	32.2	26	12	14	14.2	129.7	10.1		CL
7/30/21	ZN-CS-5	Borrow Source	84.4	36.3	29	13	16	13.4	129.2	11.0		CL
8/10/21	ZN-CS-6	Borrow Source	80.5	24.4	24	12	12	14.6	131.3	9.5		CL
8/18/21	ZN-CS-7	Borrow Source	82.9	27.4	25	12	13	14.7	132.0	9.9		CL
8/20/21	ZN-CS-8	Borrow Source	80.2	30.3	25	12	13	13.0	132.5	8.7		CL
8/23/21	ZN-CS-9	Borrow Source	83.1	32.5	25	12	13	14.2	132.2	8.6		CL
8/24/21	ZN-CS-10	Borrow Source	72.3	24.7	22	12	10	12.7	129.8	10.8		CL
8/27/21	ZN-CS-11	Borrow Source	81.1	32.2	28	14	14	14.8	131.7	9.7		CL
8/28/21	ZN-CS-12	Borrow Source	81.7	31.8	29	14	15	14.9	129.1	10.1		CL
8/29/21	ZN-CS-13	Borrow Source	81.5	32.0	26	13	13	14.2	130.9	10.1		CL
8/30/21	ZN-CS-14	Borrow Source	79.7	33.5	28	14	14	12.1	130.4	9.3		CL
9/1/21	ZN-CS-15	Borrow Source	77.2	29.7	29	13	16	11.5	133.3	8.8		CL
Minimum:			**72.3**	**24.4**	**22**	**12**	**8**	**11.5**	**126.7**	**8.6**	**5.8×10^{-8}**	
Maximum:			**84.4**	**36.3**	**29**	**14**	**16**	**16.0**	**133.3**	**11.5**	**5.8×10^{-8}**	
Average:			**80.5**	**30.9**	**26**	**13**	**13**	**14.0**	**130.3**	**10.0**	**5.8×10^{-8}**	
Project Requirements:			**≥50.0**				**≤4.0**				**$\leq 1.0 \times 10^{-7}$**	**CL/CH**

TABLE 6

SUMMARY OF LABORATORY TEST RESULTS FOR CLAY LINER MATERIAL SAMPLED IN-PLACE

ZION LANDFILL
CELL 10C COMPOSITE LINER

NOVEMBER 2021

ASTM No.					D6913/D7928		D4318			D7263	D2216	D5084	D2487	D2216
					Grain Size Analysis		Atterberg Limits			Dry	Water	Coefficient		Sampled
Date	Sample	Lift	Coordinates		%Fines	%Clay	Liquid	Plastic	Plasticity	Density	Content	Permeability		Water
Sampled	Number	No.	North	East	<#200	<.002	Limit	Limit	Index	(pcf)	(%)	(cm/sec)	U.S.C.S.	Content
7/9/21	ZN-CL-1	1	11100	12025	90.0	40.5	29	14	15	125.9	13.4	7.6×10^{-8}	CL	13.3
8/19/21	ZN-CL-2	2	11150	12375	82.7	32.5	25	12	13	125.2	14.2	9.5×10^{-8}	CL	16.3
8/23/21	ZN-CL-3	2	10949	12776	79.6	31.0	26	13	13	124.7	14.8	3.0×10^{-8}	CL	13.1
7/22/21	ZN-CL-4	3	11000	11925	84.9	37.4	30	14	16	118.2	16.1	3.2×10^{-8}	CL	16.7
7/13/21	ZN-CL-5	4	11206	12075	81.8	33.1	30	13	17	120.4	16.8	2.7×10^{-8}	CL	12.3
8/24/21	ZN-CL-6	4	11049	12875	80.2	28.1	23	12	11	119.3	13.4		CL	13.6
8/17/21	ZN-CL-7	5	11100	12725	82.6	27.8	26	13	13	125.1	14.2	6.4×10^{-8}	CL	15.2
7/29/21	ZN-CL-8	6	10868	11826	82.0	34.2	28	13	15	120.2	16.3	4.1×10^{-8}	CL	15.8
8/28/21	ZN-CL-9	6	11050	12574	77.5	27.0	27	13	14	128.7	14.0		CL	15.7
7/20/21	ZN-CL-10	7	11199	12324	84.5	37.6	29	14	15	122.8	13.7	8.4×10^{-8}	CL	13.8
8/31/21	ZN-CL-11	8	11205	12375	80.4	31.7	28	13	15	125.1	14.1		CL	13.9
8/30/21	ZN-CL-12	8	10951	12823	79.7	30.6	28	13	15	125.6	13.2	6.2×10^{-8}	CL	13.4
7/21/21	ZN-CL-13	9	11100	12325	81.2	33.6	26	13	13	121.2	13.4	9.1×10^{-8}	CL	14.3
7/24/21	ZN-CL-14	10	11150	11875	83.3	34.4	26	12	14	122.5	15.2		CL	13.6
8/31/21	ZN-CL-15	10	11049	12475	80.2	32.1	28	13	15	125.7	13.9	5.3×10^{-8}	CL	12.7
Minimum:					**77.5**	**27.0**	**23**	**12**	**11**	**118.2**	**13.2**	**2.7×10^{-8}**		**12.3**
Maximum:					**90.0**	**40.5**	**30**	**14**	**17**	**128.7**	**16.8**	**9.5×10^{-8}**		**16.7**
Average:					**82.0**	**32.8**	**27**	**13**	**14**	**123.4**	**14.4**	**6.0×10^{-8}**	**CL**	**14.2**
Project Requirements:					**≥50.0**				**>4.0**			**$\leq 1.0 \times 10^{-7}$**	**CL/CH**	

ATTACHMENT 9
Existing Flare System
Design Drawings and Specifications

V. DESIGN BASIS

Gas Stream

Type:	landfill
Composition:	55% CH_4 (maximum)
	45% CO_2, air, inert gases
Lower Heating Value:	501 BTU/SCF
Temperature:	100 °F
Molecular Weight:	29
Flow Rate:	6000 SCFM (maximum)
	600 SCFM (minimum)
Heat Release *:	180,000,000 BTU/hr (maximum)

* lower heating value basis

CAUTION

Flame flashback may occur if the gas stream contains an amount of oxygen within the explosive limit.

NOTE

Methane concentrations less than 30% may require the addition of enrichment fuel for stable combustion.

Process Design

Smokeless Capacity:	100%
Destruction Efficiency:	98% (minimum)
Operating Temperature:	1400 °F to 1800 °F (2000 °F shutdown)
Retention Time:	0.7 second at 1800 °F (minimum)
Flare Inlet Pressure:	5" H_2O (maximum)
Ambient Pressure:	14.4 psia

Mechanical Design

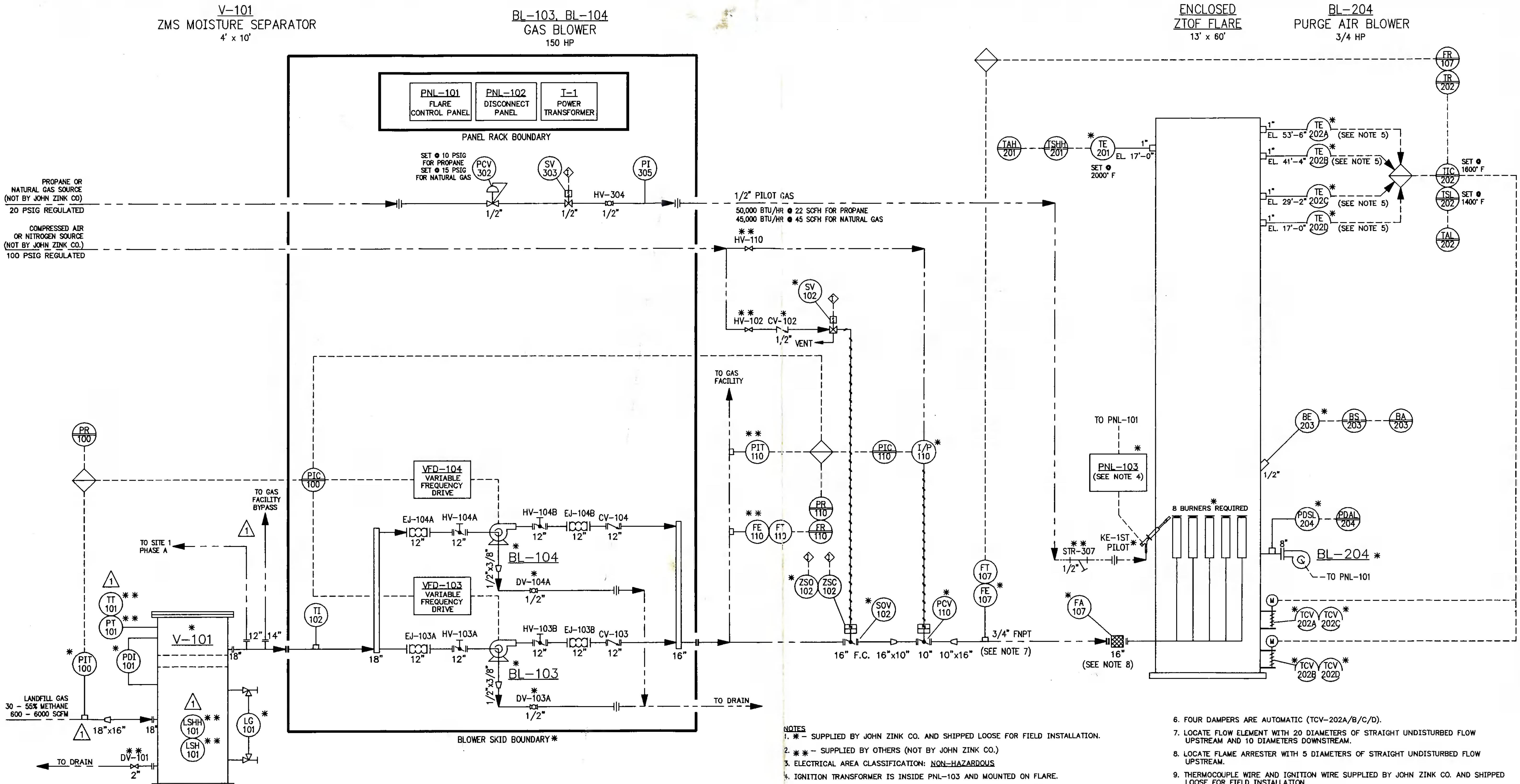
Wind Speed Classification:	110 mph
Seismic Classification:	zone 4
Ambient Temperature:	32 to 120 °F
Electrical Area Classification:	non-hazardous
Site Elevation:	750' above sea level

Blower Design

Quantity:	two
Capacity:	3000 SCFM each (maximum)
Horsepower:	150 HP
Pressure Differential:	-100" H_2O suction
	2.50 psig discharge

Utility Requirements

Pilot Gas:	22 SCFH of propane at 10 psig 45 SCFH of natural gas at 15 psig
Compressed Air or Nitrogen:	100 psig (minimum) dry
Electrical:	480 V, three phase, 60 Hz for gas blower control 120 V, single phase, 60 Hz for control components



NOTES

1. * – SUPPLIED BY JOHN ZINK CO. AND SHIPPED LOOSE FOR FIELD INSTALLATION.
2. ** – SUPPLIED BY OTHERS (NOT BY JOHN ZINK CO.)
3. ELECTRICAL AREA CLASSIFICATION: NON-HAZARDOUS
4. IGNITION TRANSFORMER IS INSIDE PNL-103 AND MOUNTED ON FLARE.
5. TEMPERATURE CONTROL THERMOCOUPLE (TE-202) IS SELECTED DEPENDING ON GAS FLOW RATE TO FLARE. EQUIPMENT DAMAGE MAY OCCUR IF THE IMPROPER ELEVATION IS SELECTED.
6. FOUR DAMPERS ARE AUTOMATIC (TCV-202A/B/C/D).
7. LOCATE FLOW ELEMENT WITH 20 DIAMETERS OF STRAIGHT UNDISTURBED FLOW UPSTREAM AND 10 DIAMETERS DOWNSTREAM.
8. LOCATE FLAME ARRESTER WITH 5 DIAMETERS OF STRAIGHT UNDISTURBED FLOW UPSTREAM.
9. THERMOCOUPLE WIRE AND IGNITION WIRE SUPPLIED BY JOHN ZINK CO. AND SHIPPED LOOSE FOR FIELD INSTALLATION.

HIGH TEMPERATURE SHUTDOWN THERMOCOUPLE LOCATION

GAS FLOW (SCFM)	TE-201 ELEVATION (FT)
ALL FLOW RATES	17'-0"

TEMPERATURE CONTROL THERMOCOUPLE LOCATION
AT MAXIMUM METHANE CONCENTRATION

GAS FLOW (SCFM)	TE-202 ELEVATION (FT)
600 – 1950	17'-0"
1950 – 3300	29'-2"
3300 – 4650	41'-4"
4650 – 6000	53'-6"

LEGEND

- FIELD MOUNTED INSTRUMENT
- REMOTE PANEL MOUNTED NORMALLY ACCESSIBLE TO OPERATOR
- LOCAL PANEL MOUNTED NORMALLY ACCESSIBLE TO OPERATOR
- REMOTE SUB-PANEL MOUNTED NORMALLY INACCESSIBLE TO OPERATOR
- LOCAL SUB-PANEL MOUNTED NORMALLY INACCESSIBLE TO OPERATOR
- LOCATED IN THE PLC
- INTERLOCK TO/FROM CONTROL PANEL
- PIPE & FITTINGS BY OTHERS (NOT BY JOHN ZINK CO.)
- ELECTRICAL INTERCONNECTIONS
- INSTRUMENT CONTROL AIR LINE
- PIPE & FITTINGS BY JOHN ZINK CO.

FOR: VEOLIA ENVIRONMENTAL SERVICES
USER: ZION LANDFILL
JOBSITE: ZION, ILLINOIS
S.O. NO. BF-9062818
P.O. NO. BF-00059812

JOHN ZINK
JOHN ZINK COMPANY LLC
PARTS AND SERVICE, CALL 1-800-755-4252 FAX (918) 234-1968

PROCESS & INSTRUMENT DIAGRAM
FOR AN ENCLOSED ZTOF FLARE SYSTEM

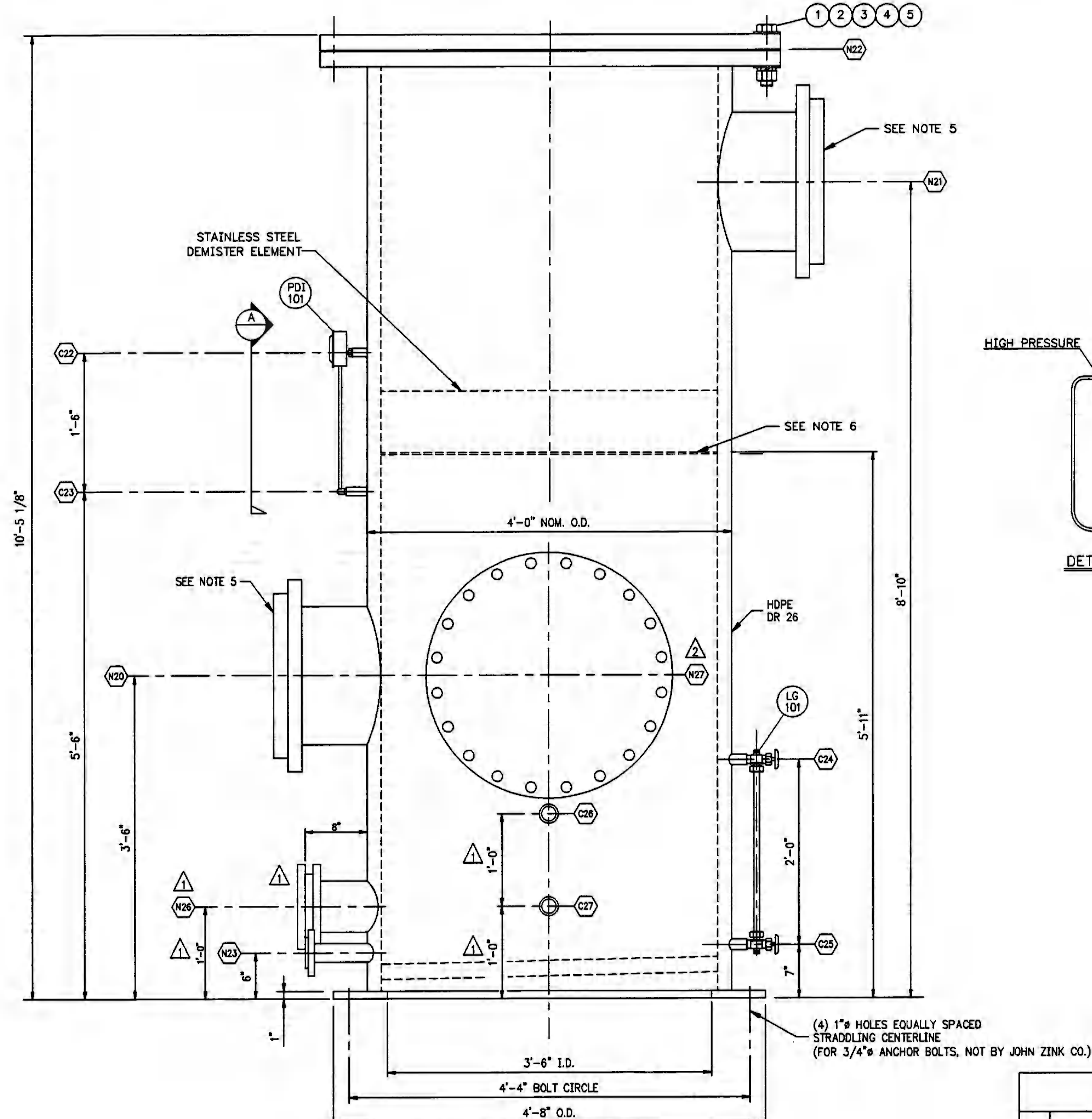
NO.	REVISION DESCRIPTION	BY	CK.	APP.	DATE
1	REVISED PER CUSTOMER COMMENTS	JWC	SAM	JPR	3-31-07

DR.	SAM	DATE: 2-20-07
CK.	JPR	DATE: 2-23-07
APP.	JPR	DATE: 2-23-07

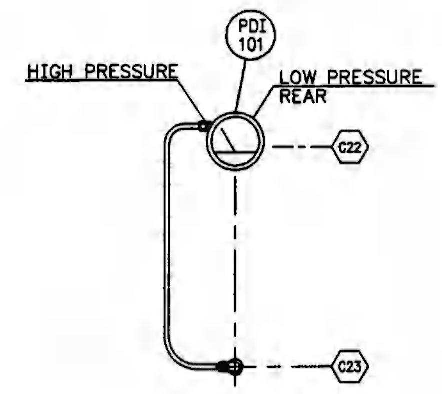
CERTIFIED
DATE:
DRAWING NUMBER B-F-9062818-150
REV. 1
SCALE NONE
1 of 1

PARTS LIST				
ITEM	QTY	DESCRIPTION	MK: DWG	MATERIAL
1	1	GASKET: 1/8" THICK		NEOPRENE
2	44	HEX BOLT, 1 1/2" x 7" LG (PLATED)		A-307
3	44	NUT, REG HEX: 1 1/2" (PLATED)		A-307
4	88	WASHER, 1 1/2" FLAT (PLATED)		A-569
5	44	WASHER, 1 1/2" LOCK (PLATED)		A-569

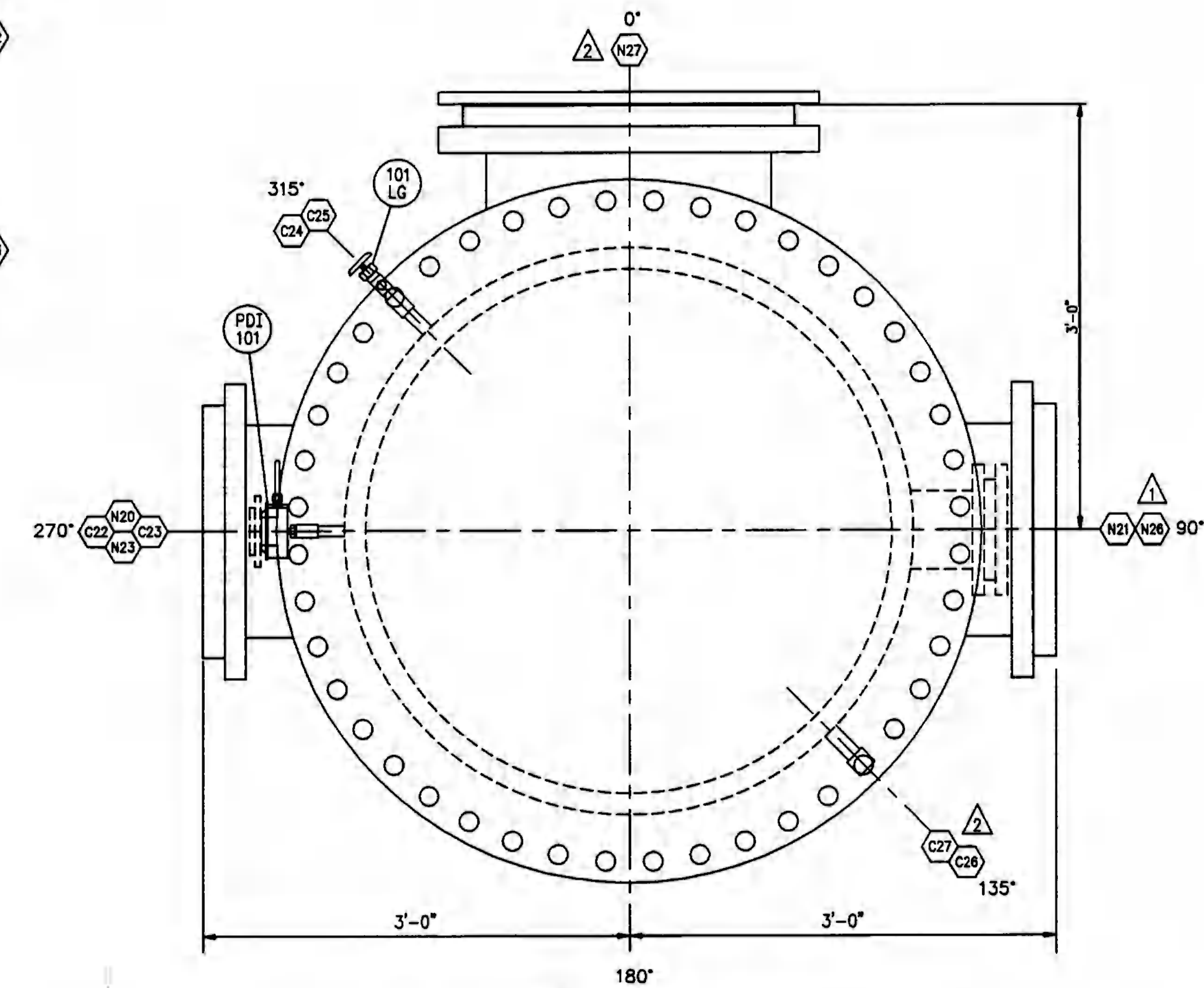
NOZZLE LEGEND			
	MK	QTY	DESCRIPTION
	N20	1	INLET: 18" FLANGE ADAPTER WITH 150# BACK-UP RING
	N21	1	OUTLET: 18" FLANGE ADAPTER WITH 150# BACK-UP RING
	N22	1	FLANGED TOP: 59 1/2" O.D. WITH (44) 1 5/8" ø HOLES ON 56" DIA B.C.
	N23	1	DRAIN: 2" FLANGE ADAPTER WITH 150# BACK-UP RING
1	N26	1	ACCESS: 6" FLANGE WITH 150# BACK-UP RING & BLIND FLANGE
2	N27	1	INLET: 24" FLANGE ADAPTER WITH 150# BACK-UP RING AND BLIND FLANGE
	C22	1	PRESSURE CONNECTION: 1/2" FNPT (SS)
	C23	1	PRESSURE CONNECTION: 1/2" FNPT (SS)
	C24	1	LIQUID LEVEL GAUGE CONNECTION: 3/4" FNPT (SS)
	C25	1	LIQUID LEVEL GAUGE CONNECTION: 3/4" FNPT (SS)
	C26	1	LIQUID LEVEL SWITCH CONNECTION: 1 1/4" FNPT WITH SS PLUG
1	C27	1	LIQUID LEVEL SWITCH CONNECTION: 1 1/4" FNPT WITH SS PLUG



ELEVATION
(NOT TRUE ORIENTATION)
(MK: V-101)



DETAIL A



PLAN VIEW
(TRUE ORIENTATION)

NOTES

1. BOLTS HOLES TO STRADDLE NORMAL CENTERLINES UNLESS NOTED.
2. MOISTURE SEPARATOR IS NOT TO BE USED AS AN ANCHOR POINT FOR CUSTOMER PIPING.
3. PRE-TENSION ANCHOR BOLTS BY THE "TURN OF THE NUT" METHOD/AISC.
4. TAG NO'S. TO BE PRECEDED BY JOHN ZINK SALES ORDER NO.
5. FLANGE ADAPTERS TO BE SDR-17 AND BACK-UP RINGS TO BE PAINTED.
6. DEMISTER MOUNTING RING 1/4" THK. MIN. x 2" WIDE WITH (16) 1/4" ø BOLT HOLES.

DESIGN DATA

VACUUM ____________ -5 PSI
EMPTY WEIGHT ____________ 1600 LBS.

FOR: VEOLIA ENVIRONMENTAL SERVICES
USER: ZION LANDFILL
JOBSITE: ZION, ILLINOIS
S.O. NO. BF-9062818
P.O. NO. BF-00059812

JOHN ZINK
JOHN ZINK COMPANY LLC
PARTS AND SERVICE, CALL 1-800-755-4252 FAX (918) 234-1968

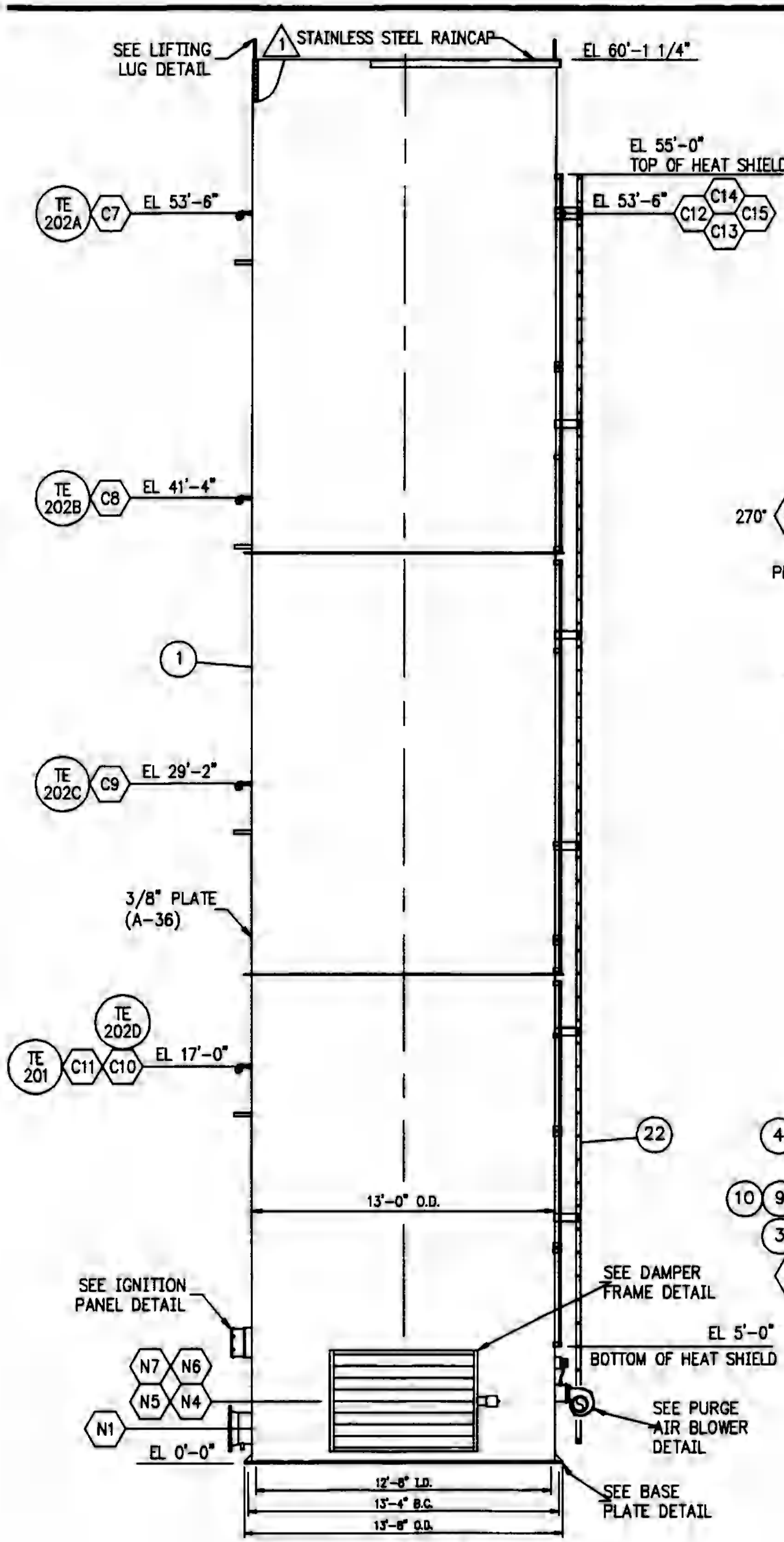
ZMS MOISTURE SEPARATOR
4' O.D. x 10' HIGH

NO.	REVISION DESCRIPTION	BY	CK.	APP.	DATE
2	PER CHANGE ORDER 01 [VDR-01]	SAM	SAM	JPR	5-23-07
1	REVISED PER CUSTOMER COMMENTS	JWC	SAM	JPR	3-31-07

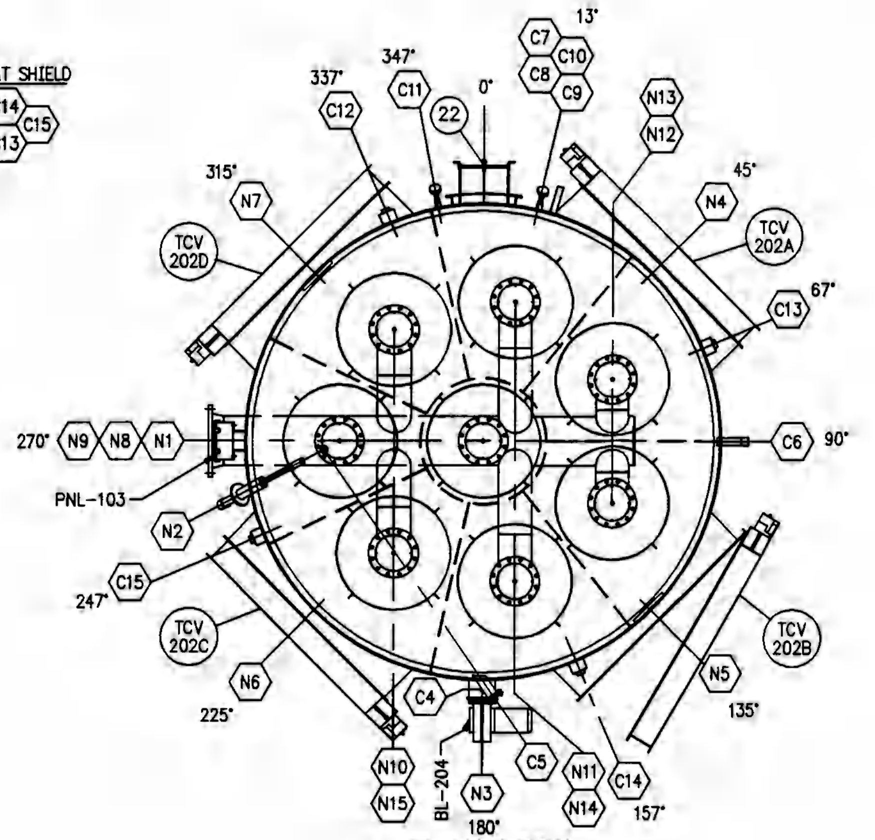
DR.	BP	DATE: 2/21/07
CK.	SAM	DATE: 2/23/07
APP.	JPR	DATE: 2/23/07

CERTIFIED
DATE:

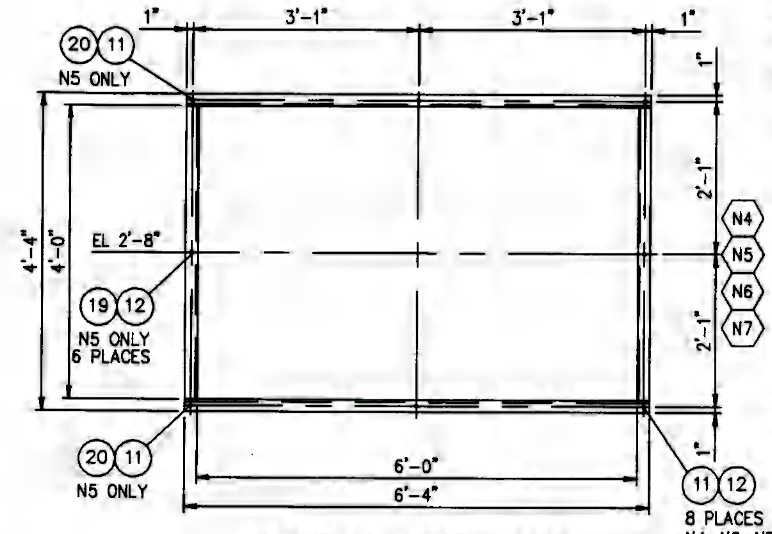
DRAWING NUMBER 8-F-9062818-303
REV. 2
SCALE
1 of 1



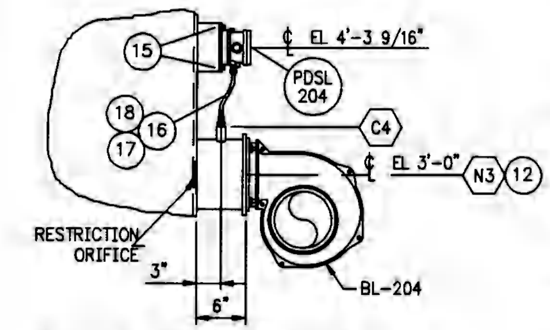
ELEVATION
NOT TRUE ORIENTATION



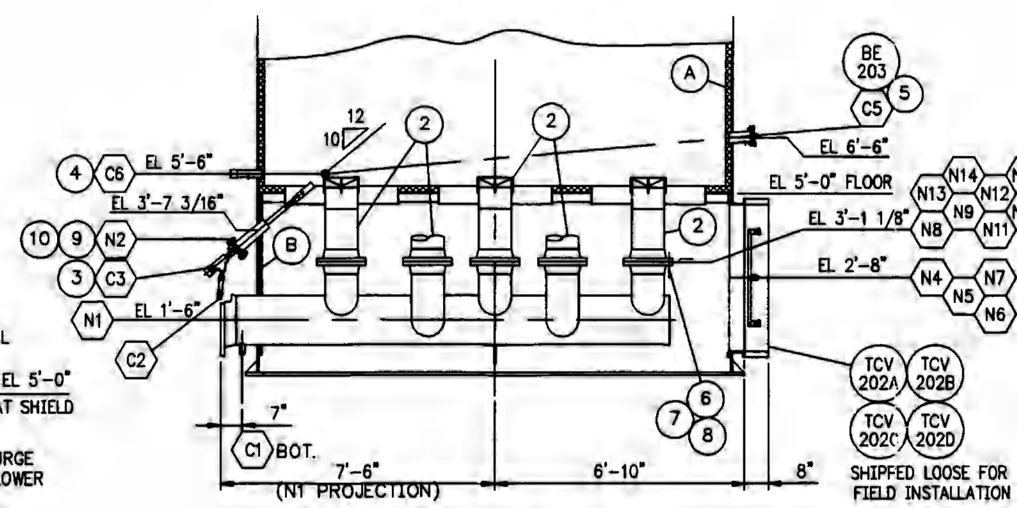
PLAN VIEW
TRUE ORIENTATION



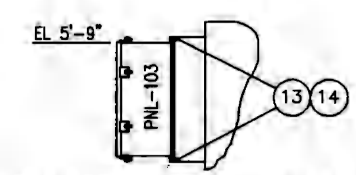
DAMPER FRAME DETAIL



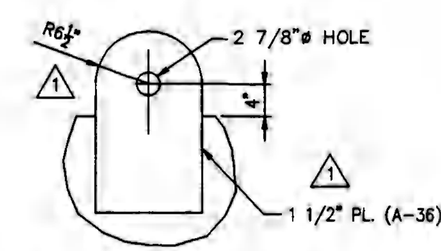
PURGE AIR BLOWER DETAIL
SHIPPED LOOSE FOR FIELD INSTALLATION



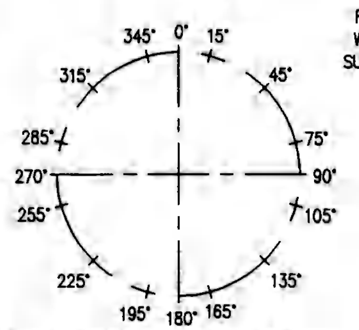
PARTIAL SECTIONAL ELEVATION
NOT TRUE ORIENTATION



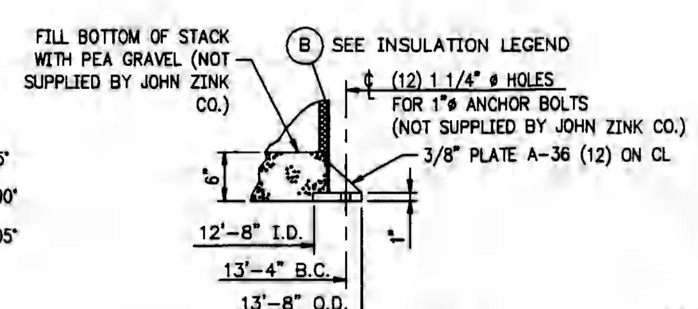
IGNITION PANEL DETAIL
SHIPPED LOOSE FOR FIELD INSTALLATION



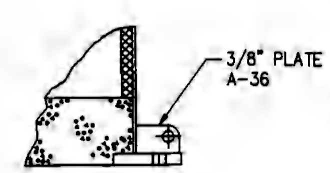
LIFTING LUG DETAIL
(2 REQ'D. LOCATED AT 135° AND 315°)
(NOTE: CUT OFF LUGS AFTER STACK ERECTION)



FOUNDATION BOLT PATTERN



BASE PLATE DETAIL



GROUNDING LUG DETAIL
(LOCATE AT 85°)

PARTS LIST

ITEM	QTY	DESCRIPTION	MK: NO	MATERIAL
1	1	ENCLOSED ZTOF FLARE	B-701-1	
2	8	10" FLARE TIP	D-ST-1330-1	
3	1	PILOT ASSEMBLY	B-302-1	
4	1	2" SIGHT PORT	CA-ST-0600	
5	1	SWIVEL SCANNER MOUNT ASSEMBLY	ST11065-1	
6	8	GASKET: 10" 150# RF x 1/16" THK	G10-150-R	NON-ASB
7	96	BOLT, STUD: 7/8" x 5" LG (PLATED)	SB-7-5	A-193-B7
8	192	NUT, HVY HEX: 7/8-9NC (PLATED)	SN-7	A-194-2H
9	4	BOLT, HEX HD: 5/8" x 2 1/2" LG (PLATED)	HB-5-2 1/2	A-307
10	4	NUT, REG HEX: 5/8-11NC (PLATED)	HN-5	A-307
11	26	BOLT, HEX HD: 3/8" x 1 1/4" LG (PLATED)	HB-3-1 1/4	A-307
12	34	NUT, REG HEX: 3/8-16NC (PLATED)	HN-3	A-307
13	4	BOLT, HEX HD: 1/4" x 1" LG (PLATED)	HB-2-1	A-307
14	4	NUT, REG HEX: 1/4-20NC (PLATED)	HN-2	A-307
15	2	SCREW, HEX HD MACH: #10-24NC x 3/4" LG (PLATED)	HCS-#10-3/4	A-307
16	1	3/8" COPPER TUBING x 1'-0" LG		COPPER
17	1	MALE CONNECTOR, 1/8" NPT x 3/8" TUBING		BRASS
18	1	MALE ELBOW CONNECTOR, 1/2" NPT x 3/8" TUBING		BRASS
19	6	SCREW, FLAT HD. SL: 3/8-NC x 1" LG. (PLATED)	FH-3-1	A-307
20	2	WING NUT: 3/8-16NC (PLATED)	WN-3	A-307
21	1 GAL	ZINC CLAD II HS #B69VZ3 (TOUCH-UP)		PAINT
22	1	GALVANIZED LADDER WITH PERSONNEL PROTECTION SCREEN, SAF-T HARNESS, SAF-T-LOK SLEEVE, AND SAF-T-NOTCH CARRIER RAIL	B-702-1	

NOZZLE LEGEND

MK	QTY	DESCRIPTION
N1	1	GAS CONNECTION: 16" 150# F.F.
N2	1	PILOT MTG CONN: 3/8" PLATE FLG W/ 3" 150# DRILLING
N3	1	BLOWER - 8" CONN 10" O.D. x 3/8" PL W/ (4) 3/8" STUDS ON 9 1/8" B.C.
N4-7	4	DAMPER CONN - SEE DETAIL (N5 HINGED)
N8-15	8	FLARE TIP CONN - 10" 150# RF
C1	1	DRAIN - 1" FNPT WITH PLUG
C2	1	PILOT GAS CONN - 1/2" FNPT
C3	1	PILOT CONDUIT CONN - 1/2" FNPT
C4	1	PURGE AIR PRESSURE CONN - 1/2" FNPT
C5	1	SCANNER CONN - 1/2" MNPT
C6	1	SIGHT PORT - 2" MNPT
C7-11	5	THERMOCOUPLE CONN - 1" FNPT
C12-15	4	SAMPLE PORT 4" FNPT WITH PLUG

DESIGN DATA

WINDLOAD (PER ASCE 7-02, EXP. C)	110 M.P.H.
SEISMIC (PER UBC-1997)	ZONE 4
SHEAR @ BASE	21.0 K
MOMENT @ BASE	810.0 K-FT (1)
DEADLOAD	60.0 K
SHELL DESIGN TEMPERATURE	500° F
CORROSION ALLOWANCE	0.0

LIFTING NOTES

A: MAIN CRANE AT TOP REQUIRES SPREADER BAR, (NOT SUPPLIED BY JOHN ZINK CO.)
B: CHOKE STACK AT APPROX. 5'-0" EL WITH TAILING CRANE
(1) C: LIFTING LUGS DESIGNED FOR 55 TON CROSBY ANCHOR SHACKLE AND VERTICAL SLINGS.

INSULATION LEGEND

A: (1) OVERLAPPING LAYER OF 1" THICK 8 LB DENSITY, 2300° F. BACKED WITH (1) LAYER, 1" THICK 6 LB DENSITY, 2300° F. ON INCONEL PINS AND KEEPERS.
B: (1) OVERLAPPING LAYER OF 1" THICK 6 LB DENSITY, 2300° F. ON INCONEL PINS AND KEEPERS.

GENERAL NOTES

1. TAG NUMBERS TO BE PRECEDED BY JOHN ZINK SALES ORDER NUMBER.
2. FLARE ASSEMBLY IS NOT TO BE USED AS AN ANCHOR POINT FOR CUSTOMER PIPING.
3. PRE-TENSION ANCHOR BOLTS BY THE "TURN OF THE NUT" METHOD/AISC.
4. BOLT HOLES TO STRADDLE NORMAL CENTER LINES UNLESS NOTED.
5. FINISH EXTERIOR CARBON STEEL, INSIDE OF SKIRT, BOTTOM OF FLOOR PLATE, AND MANIFOLD. SANDBLAST PER SSPC-SP-6 AND PRIME WITH SHERWIN WILLIAMS ZINC CLAD II HS #B69VZ3 (3-4 MILS D.F.T.)

FOR: VEOLIA ENVIRONMENTAL SERVICES
USER: ZION LANDFILL
JOBSITE: ZION, ILLINOIS
S.O. NO. BF-9062818
P.O. NO. BF-00059812

JOHN ZINK
JOHN ZINK COMPANY LLC
PARTS AND SERVICE, CALL 1-800-755-4252 FAX (918) 234-1968

ENCLOSED ZTOF FLARE
13'-0" O.D. x 60' H.

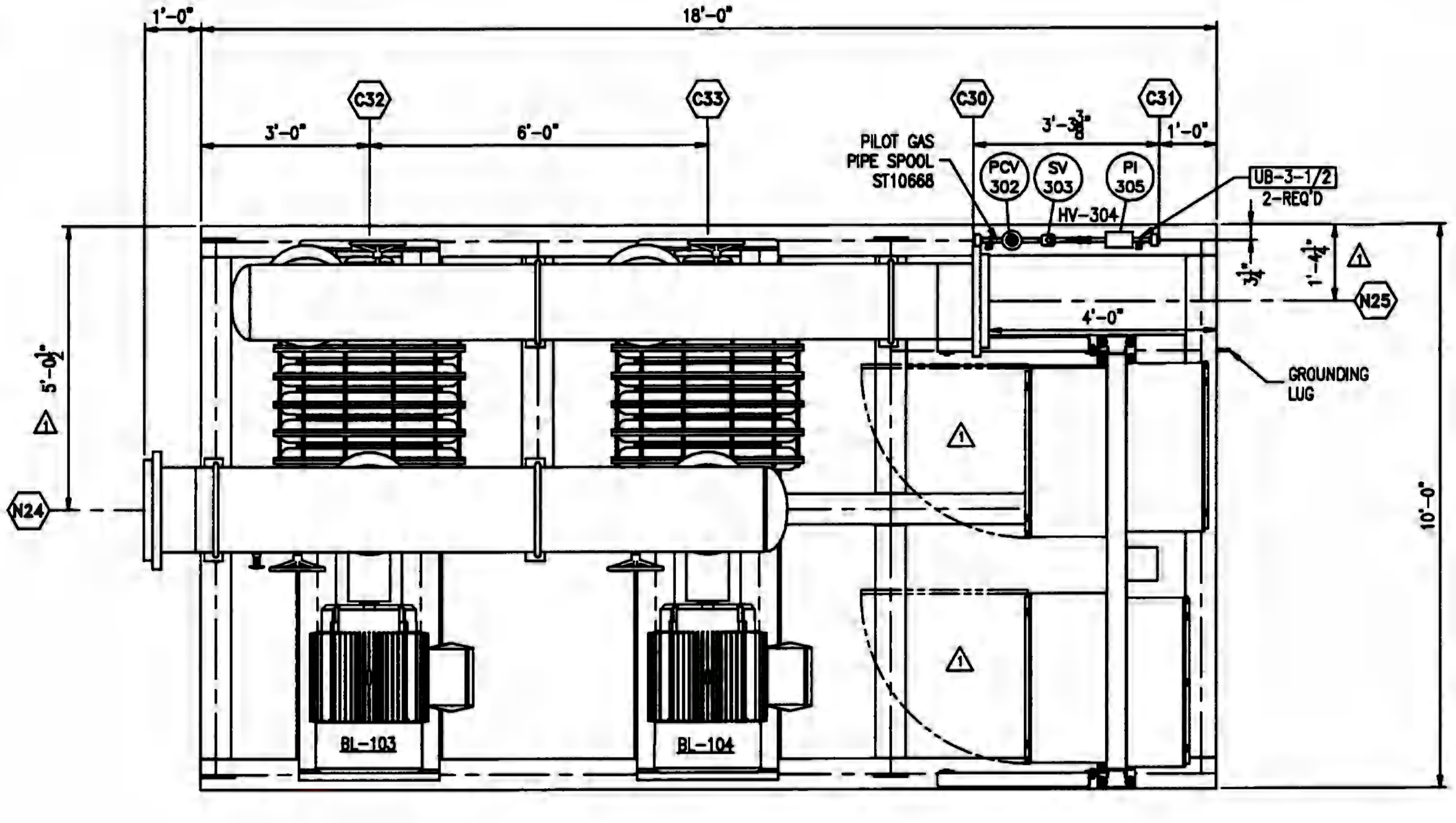
DR.	SAM	DATE: 2-20-07
CK.	SAM	DATE: 2-23-07
APP.	JPR	DATE: 2-23-07

CERTIFIED
DATE:

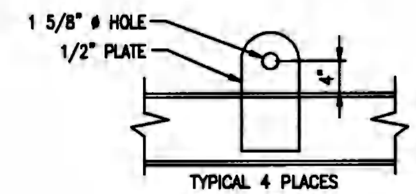
DRAWING NUMBER B-F-9062818-301
REV. 1
SCALE
1 of 1

NO.	REVISION DESCRIPTION	BY	CK.	APP.	DATE
1	REVISED PER CUSTOMER COMMENTS, AND STRUCTURAL ENGINEERING	JWC	SAM	JPR	4-9-07

NOZZLE LEGEND		
MK	QTY	DESCRIPTION
N24	1	GAS INLET: 18" FLANGE ADAPTER (HDPE) WITH 150# BACK-UP RING
N25	1	GAS OUTLET: 16" FLANGE ADAPTER (HDPE) WITH 150# BACK-UP RING
C30	1	PILOT GAS INLET – 1/2" NPT
C31	1	PILOT GAS OUTLET – 1/2" NPT
C32	1	BLOWER DRAIN – 1/2" NPT
C33	1	BLOWER DRAIN – 1/2" NPT

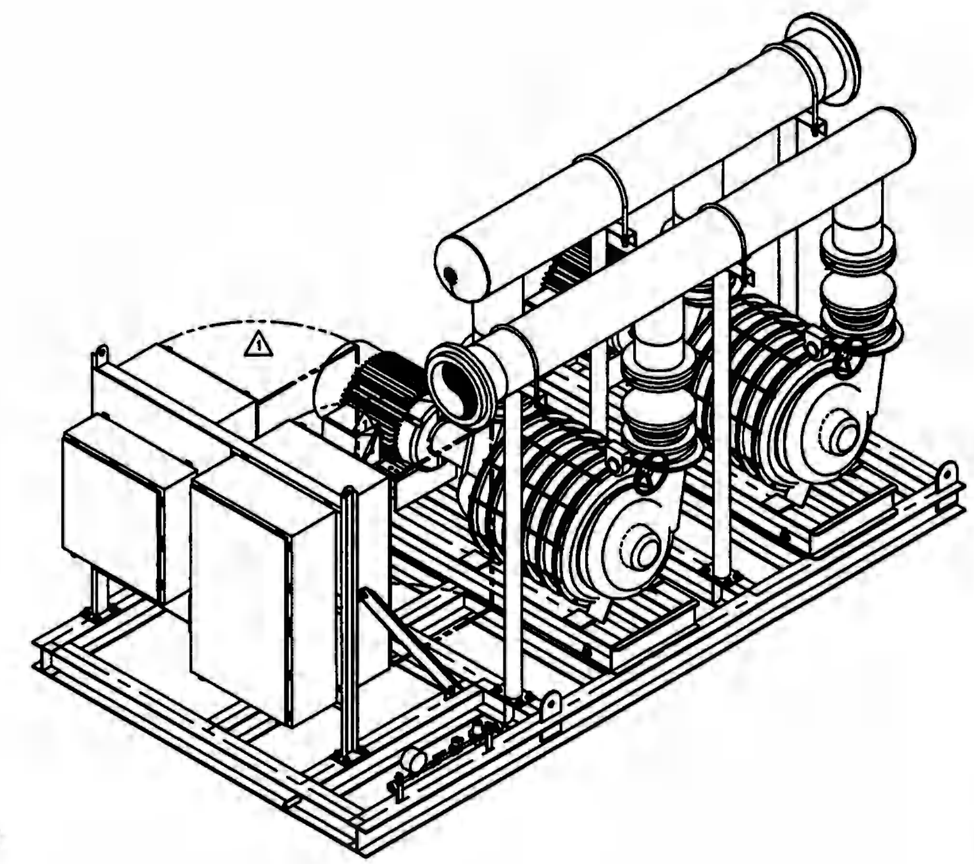


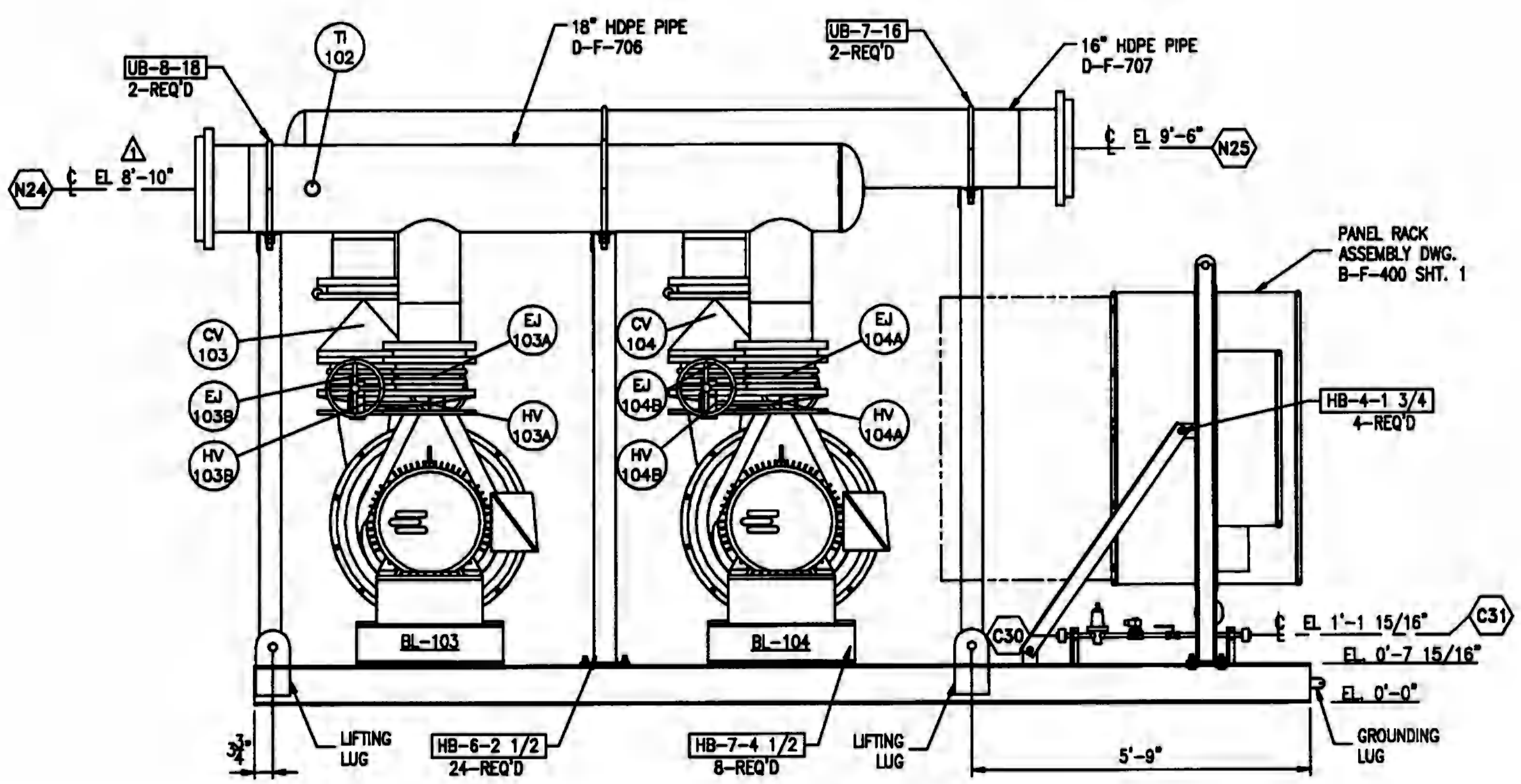
PLAN VIEW



LIFTING LUG DETAIL

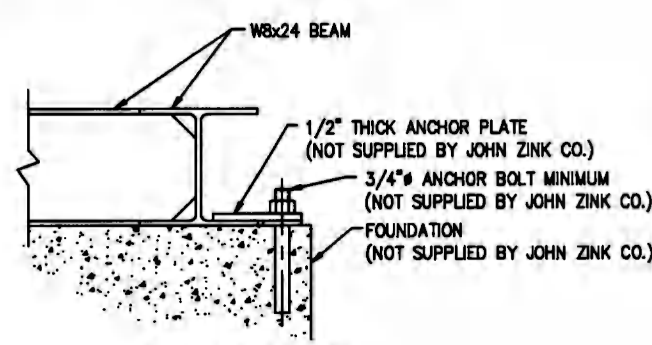
DESIGNED FOR 13 1/2 TON CROSBY ANCHOR SHACKLE





ELEVATION

(MK: B-704-1)



SKID ANCHOR DETAIL

(TYP 4 PLACES MINIMUM)

NOTES
1. PREFIX ALL MK: NO'S WITH SALES ORDER NUMBER.
2. DO NOT BOLT THE BLOWER DOWN TIGHT. DOING SO VOIDS THE WARRANTY. BLOWERS ARE MOUNTED ON VIBRATION ISOLATION PADS.
3. WEIGHT APPROX. 20,000 LBS.
4. JOHN ZINK RECOMMENDS THAT A SPREADER BAR BE USED TO LIFT SKID
5. NO ELECTRICAL AREA CLASSIFICATION.
6. SKID & PIPE SUPPORTS GALVANIZED PER ASTM A-123.

FOR: VEOLIA ENVIRONMENTAL SERVICES
USER: ZION LANDFILL
JOBSITE: ZION, ILLINOIS
S.O. NO. BF-9062818
P.O. NO. BF-00059812

JOHN ZINK
JOHN ZINK COMPANY LLC
PARTS AND SERVICE, CALL 1-800-755-4252 FAX (918) 234-1968

BLOWER SKID ASSEMBLY

NO.	REVISION DESCRIPTION	BY	CK.	APP.	DATE
2	PER ENGINEERING	SAM	SAM	JPR	5-23-07
1	REVISED PER CUSTOMER COMMENTS	JWC	SAM	JPR	3-31-07

DR.	SAM	DATE: 2-22-07
CK.	SAM	DATE: 2-23-07
APP.	JPR	DATE: 2-23-07

CERTIFIED

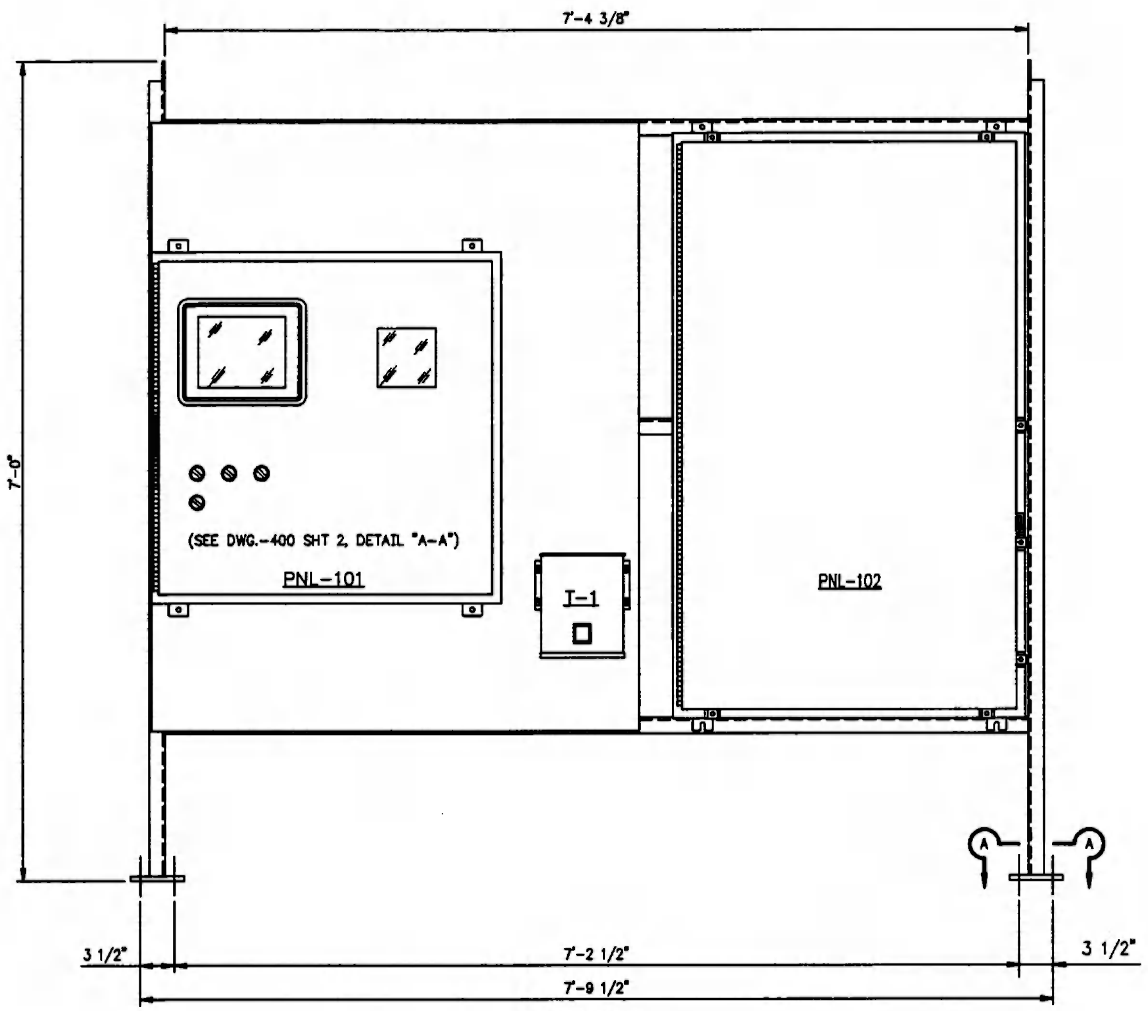
DATE:

DRAWING NUMBER B-F-9062818-304

REV. 2

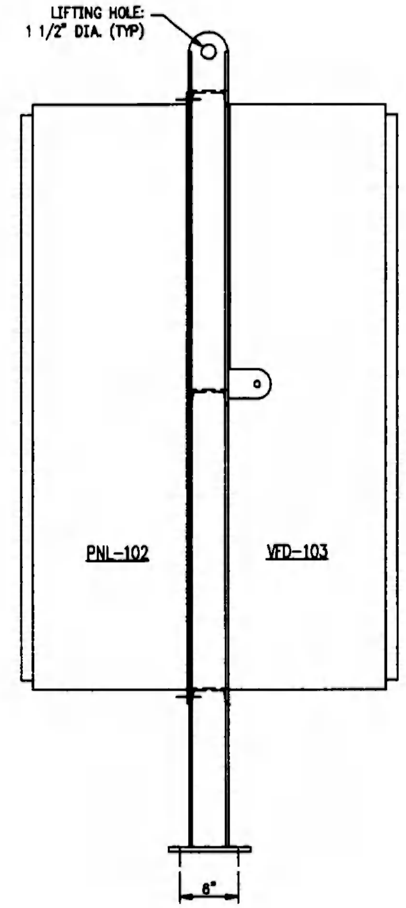
SCALE

1 of 1

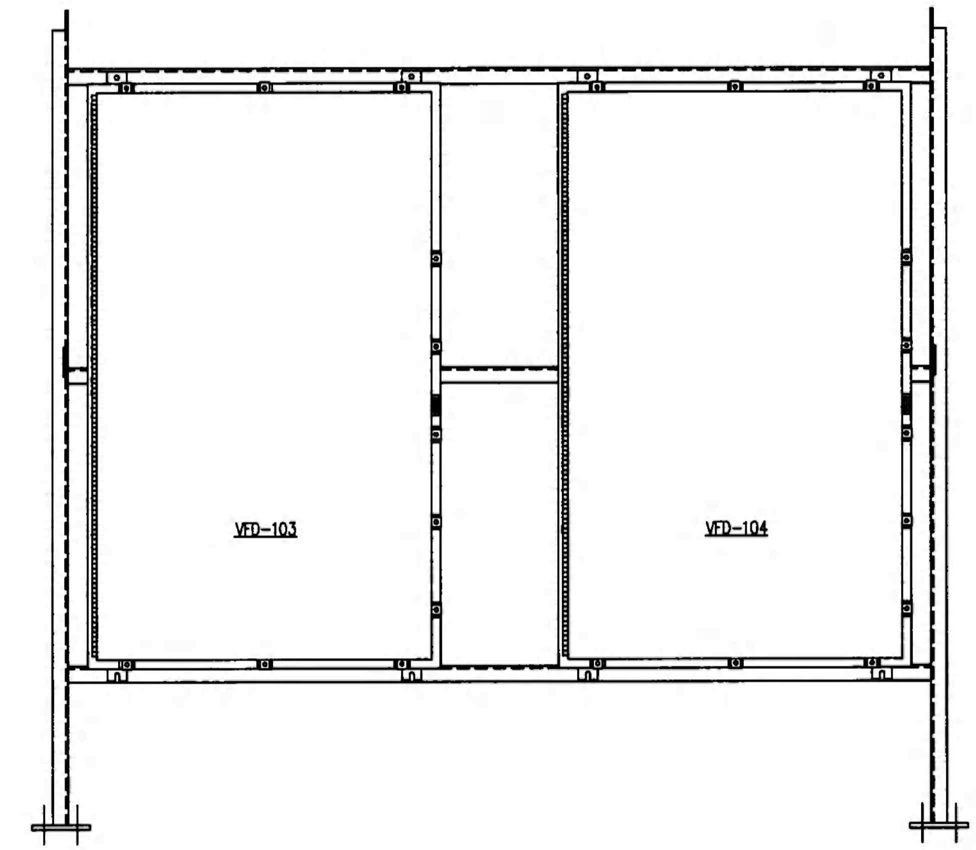


FRONT VIEW

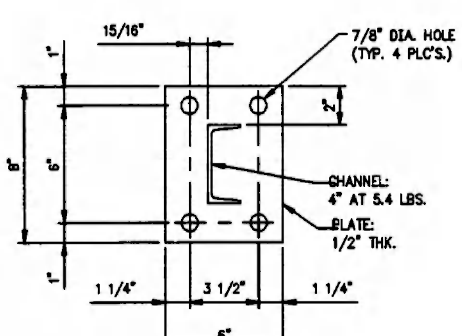
MK: B-750-1



SIDE VIEW



BACK VIEW



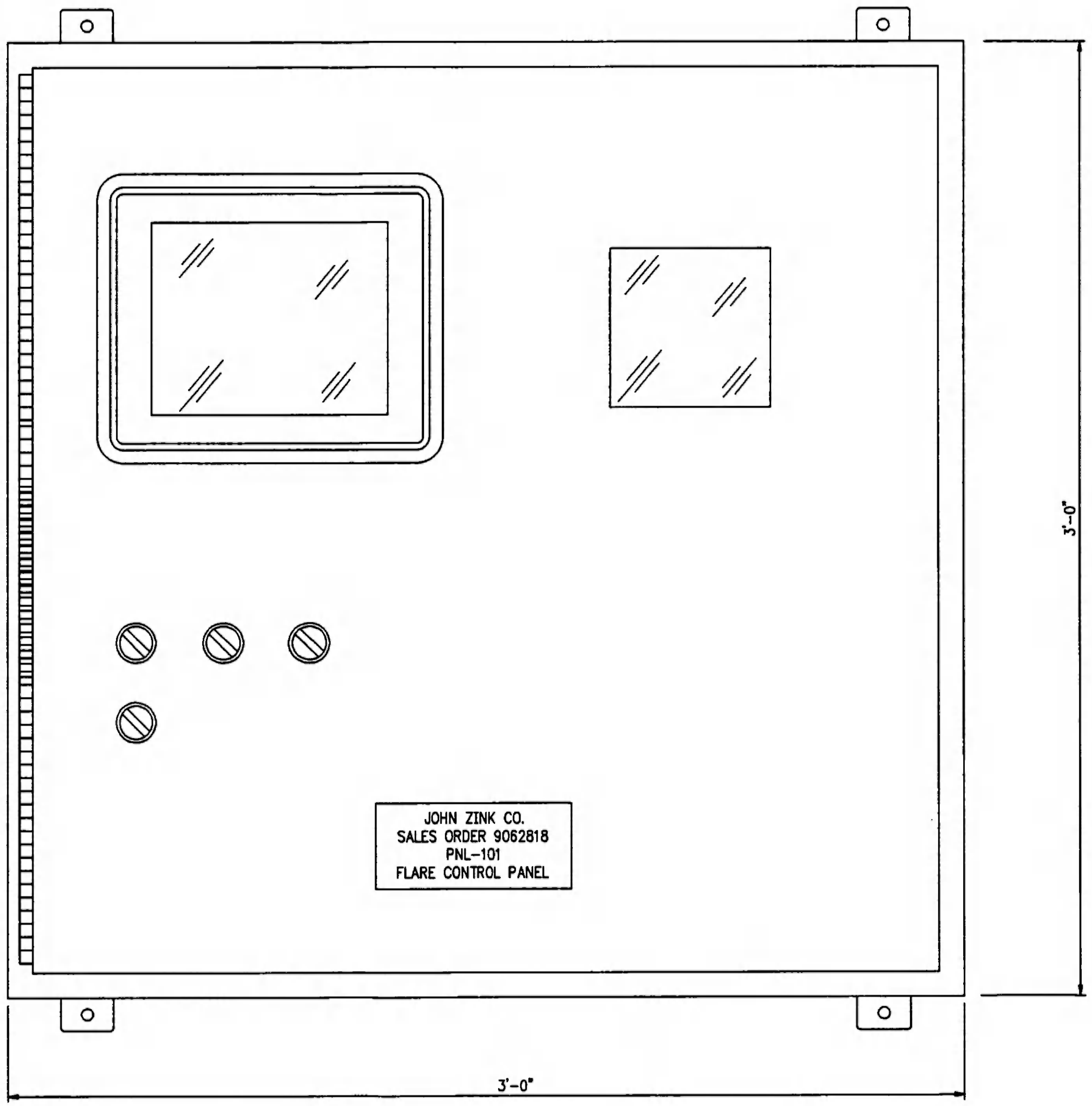
SECTION "A-A"

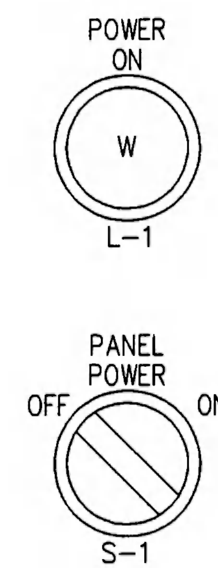
GENERAL NOTES

1. PIPING & RACK TO BE CLEANED & PAINTED PER SSPC-SP6
   PRIMER: 3-4 MILS SHERWIN WILLIAMS RECOATABLE EPOXY PRIMER #B67H5/B67V5
   FINISH: 2.5-3.0 MILS SHERWIN WILLIAMS KEM-400 ENAMEL, (ARCTIC BLUE).
2. AREA CLASSIFICATION: NON-HAZARDOUS.

NO.	REVISION DESCRIPTION	BY	CK.	APP.	DATE

FOR: VEOLIA ENVIRONMENTAL SERVICES		JOHN ZINK JOHN ZINK COMPANY LLC PARTS AND SERVICE, CALL 1-800-755-4252 FAX (918) 234-1968	
USER: ZION LANDFILL			
JOBSITE: ZION, ILLINOIS		PR-101	
S.O. NO. BF-9062818		PANEL RACK ASSEMBLY	
P.O. NO. BF-00059812			
DR. BP	DATE: 2/21/07	CERTIFIED	DRAWING NUMBER B-F-9062818-400 — REV. 0
CK. SAM	DATE: 2/23/07		SCALE NONE — 1 of 2
APP. JPR	DATE: 2/23/07	DATE:	





DETAIL "A-A"

NO.	REVISION DESCRIPTION	BY	CK.	APP.	DATE

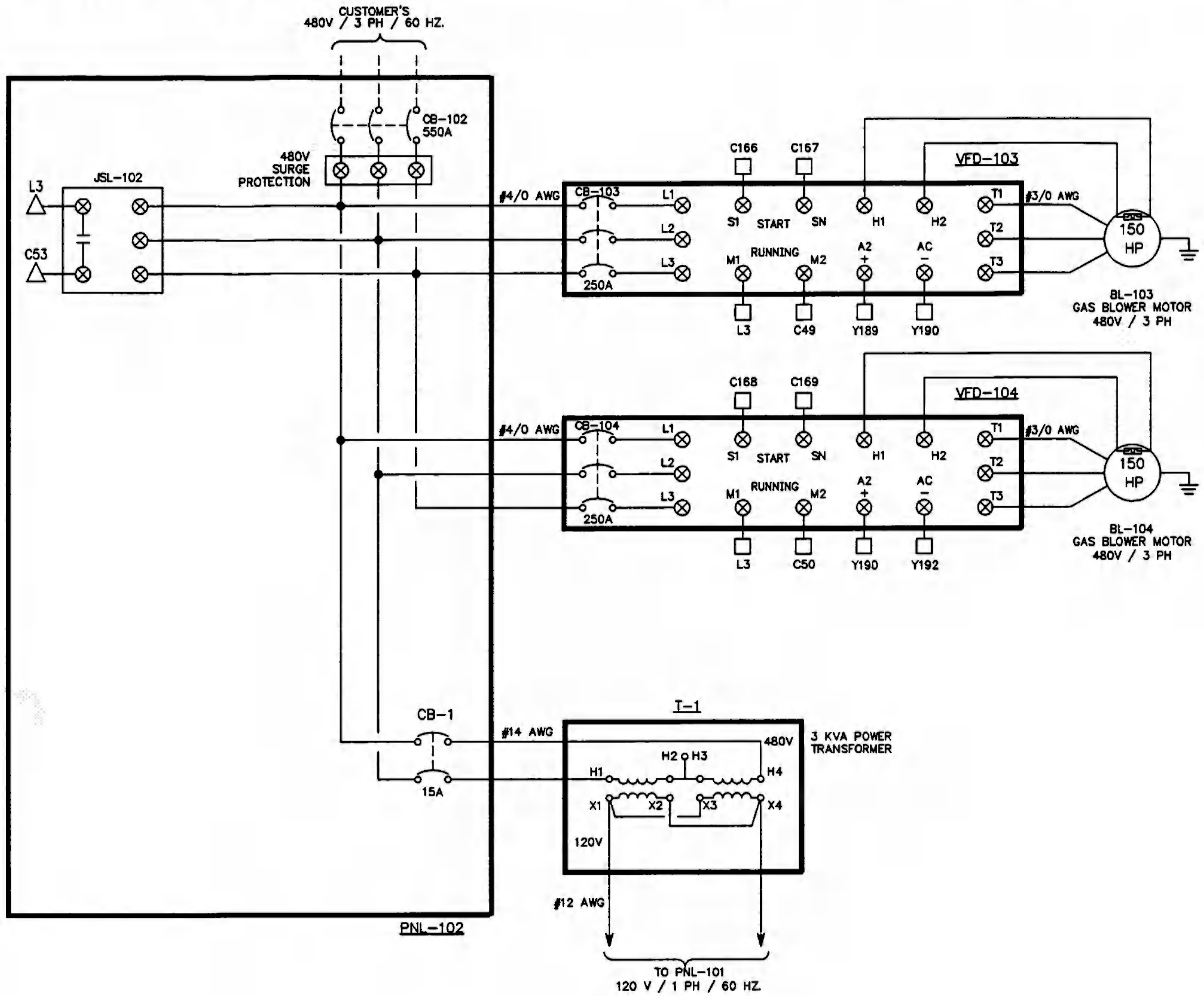
FOR: VEOLIA ENVIRONMENTAL SERVICES
USER: ZION LANDFILL
JOBSITE: ZION, ILLINOIS
S.O. NO. BF-9062818
P.O. NO. BF-00059812

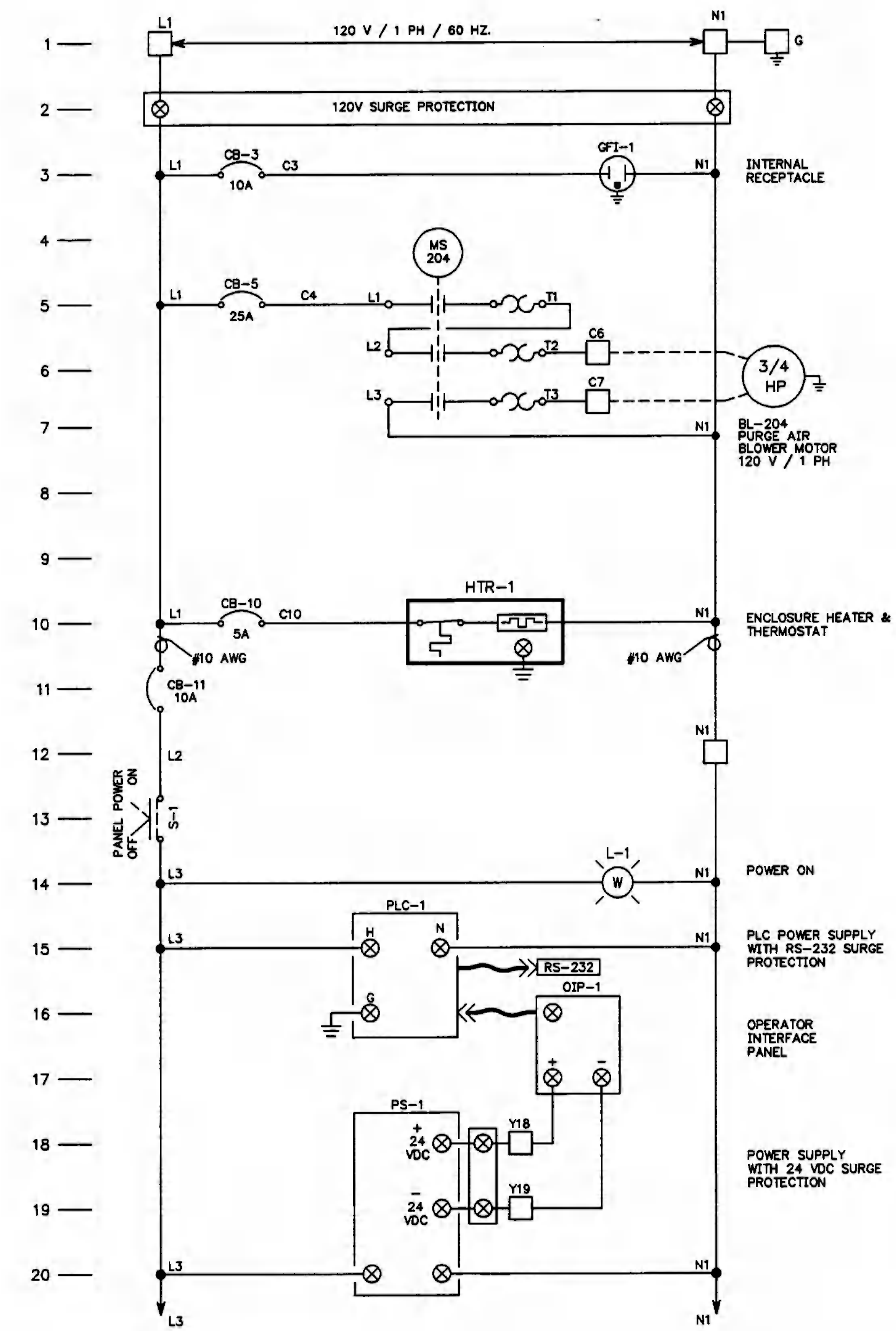
DR.	BP	DATE: 2/21/07
CK.	SAM	DATE: 2/23/07
APP.	JPR	DATE: 2/23/07

JOHN ZINK
JOHN ZINK COMPANY LLC
PARTS AND SERVICE, CALL 1-800-755-4252 FAX (918) 234-1968

PANEL DETAIL (PNL-101)
FOR AN ENCLOSED ZTOF FLARE SYSTEM

CERTIFIED	DRAWING NUMBER	REV.
	B-F-9062818-400	0
DATE:	SCALE	2 of 2





NOTES:

1. ALL WIRING TO BE AS FOLLOWS UNLESS INDICATED OTHERWISE:
   WIRE SIZING PER NEC
   MIN. 18 GA./600V/THHN OR THWN FOR CONTROL
   MIN. 18 GA./TWO CONDUCTOR SHIELDED FOR SIGNAL
2. MINIMUM FIELD CONDUIT REQUIRED:
   (1) THERMOCOUPLES
   (1) POWER – 120V
   (1) POWER – 480V
   (1) CONTROL SIGNAL
   (1) FLAME SCANNER
3. TERMINAL BLOCKS TO BE ARRANGED IN NUMERICAL ORDER.
4. PROCESSOR LOGIC PROGRAM C9062818.
5. WIRING LEGEND:
   ⊗ TERMINAL IN PANEL MOUNTED INSTRUMENTS.
   □ TERMINAL IN FLARE CONTROL PANEL PNL-101
   △ TERMINAL IN MOTOR CONTROL PANEL PNL-102
   ◪ TERMINAL IN IGNITION PANEL PNL-103
   ——— WIRING BY JOHN ZINK CO.
   - - - - - WIRING BY OTHERS

CONT'D ON DWG. 402

NO.	REVISION DESCRIPTION	BY	CK.	APP.	DATE

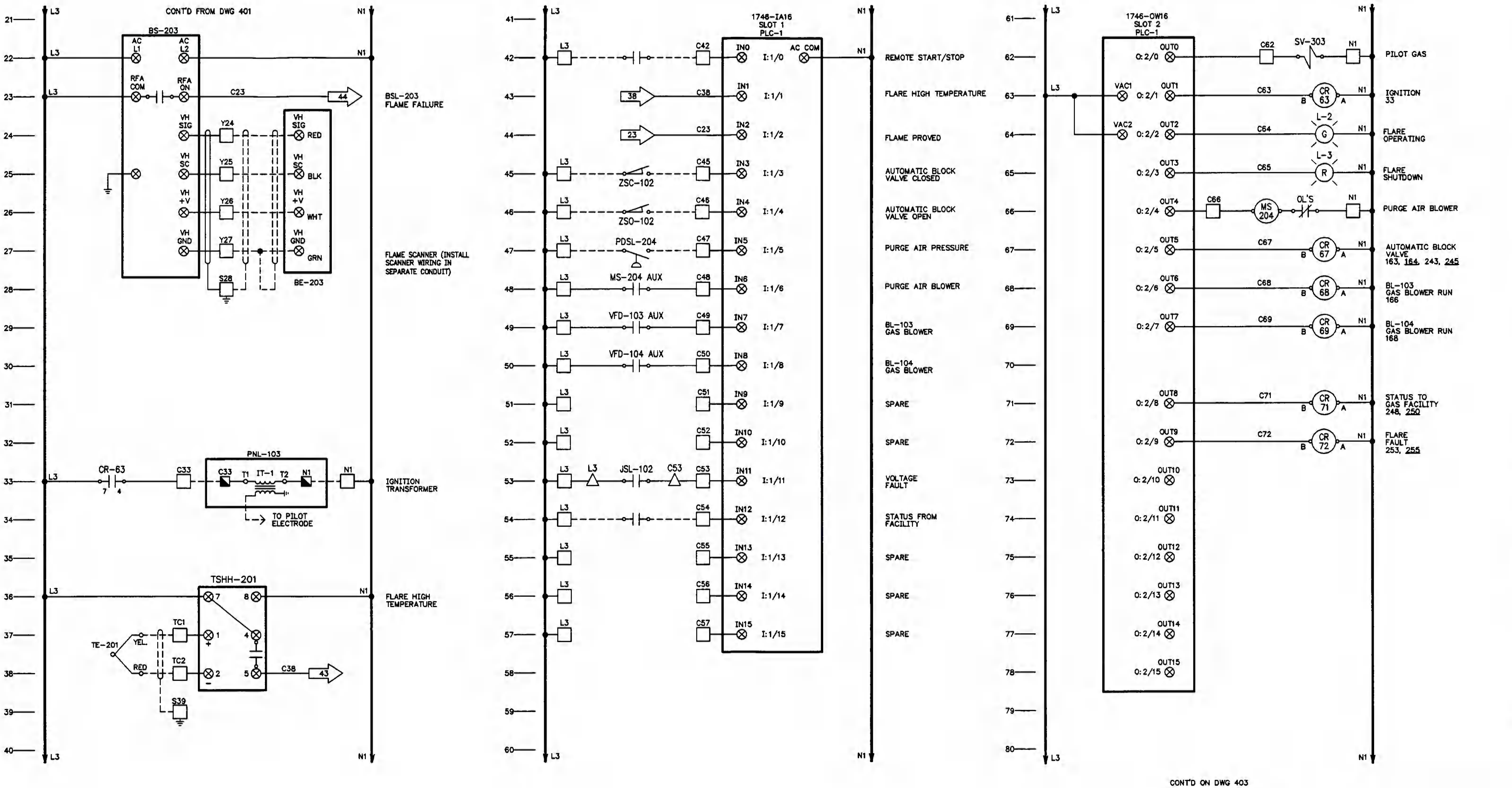
FOR: VEOLIA ENVIRONMENTAL SERVICES
USER: ZION LANDFILL
JOBSITE: ZION, ILLINOIS
S.O. NO. BF-9062818
P.O. NO. BF-00059812

DR.	BP	DATE: 2/21/07
CK.	SAM	DATE: 2/23/07
APP.	JPR	DATE: 2/23/07

JOHN ZINK
JOHN ZINK COMPANY LLC
PARTS AND SERVICE, CALL 1-800-755-4252 FAX (918) 234-1968

PNL-101 WIRING DIAGRAM
FOR AN ENCLOSED ZTOF FLARE SYSTEM

CERTIFIED	DRAWING NUMBER	REV.
DATE:	B-F-9062818-401	0
	SCALE	1 of 1



NO.	REVISION DESCRIPTION	BY	CK.	APP.	DATE

FOR: VEOLIA ENVIRONMENTAL SERVICES
USER: ZION LANDFILL
JOBSITE: ZION, ILLINOIS
S.O. NO. BF-9062818
P.O. NO. BF-00059812

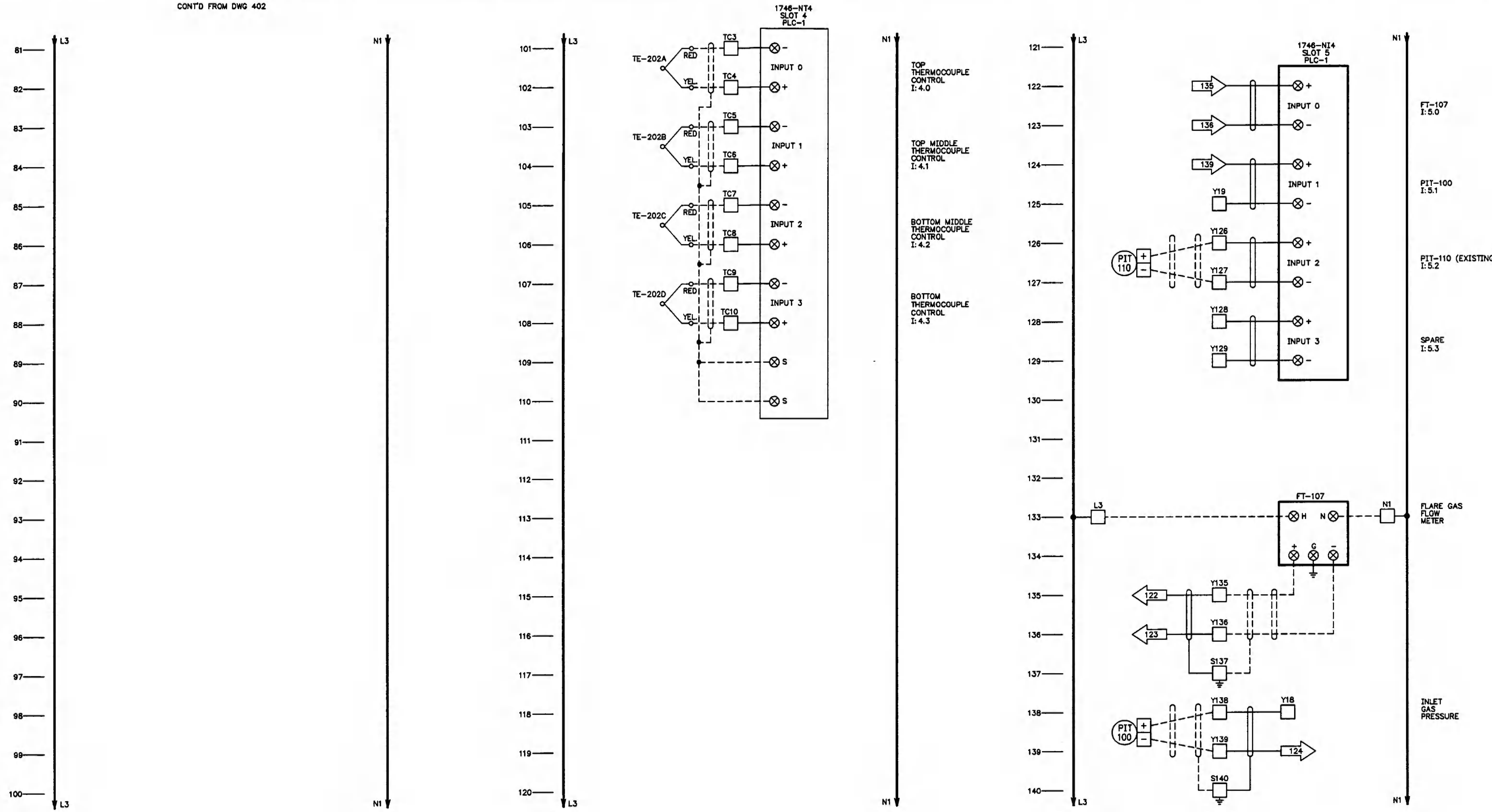
DR.	BP	DATE: 2/21/07
CK.	SAM	DATE: 2/23/07
APP.	JPR	DATE: 2/23/07

JOHN ZINK
JOHN ZINK COMPANY LLC
PARTS AND SERVICE, CALL 1-800-755-4252 FAX (918) 234-1968

PNL-101 WIRING DIAGRAM
FOR AN ENCLOSED ZTOF FLARE SYSTEM

CERTIFIED
DATE:
DRAWING NUMBER B-F-9062818-402
REV. 0
SCALE NONE
1 of 1

CONT'D FROM DWG 402

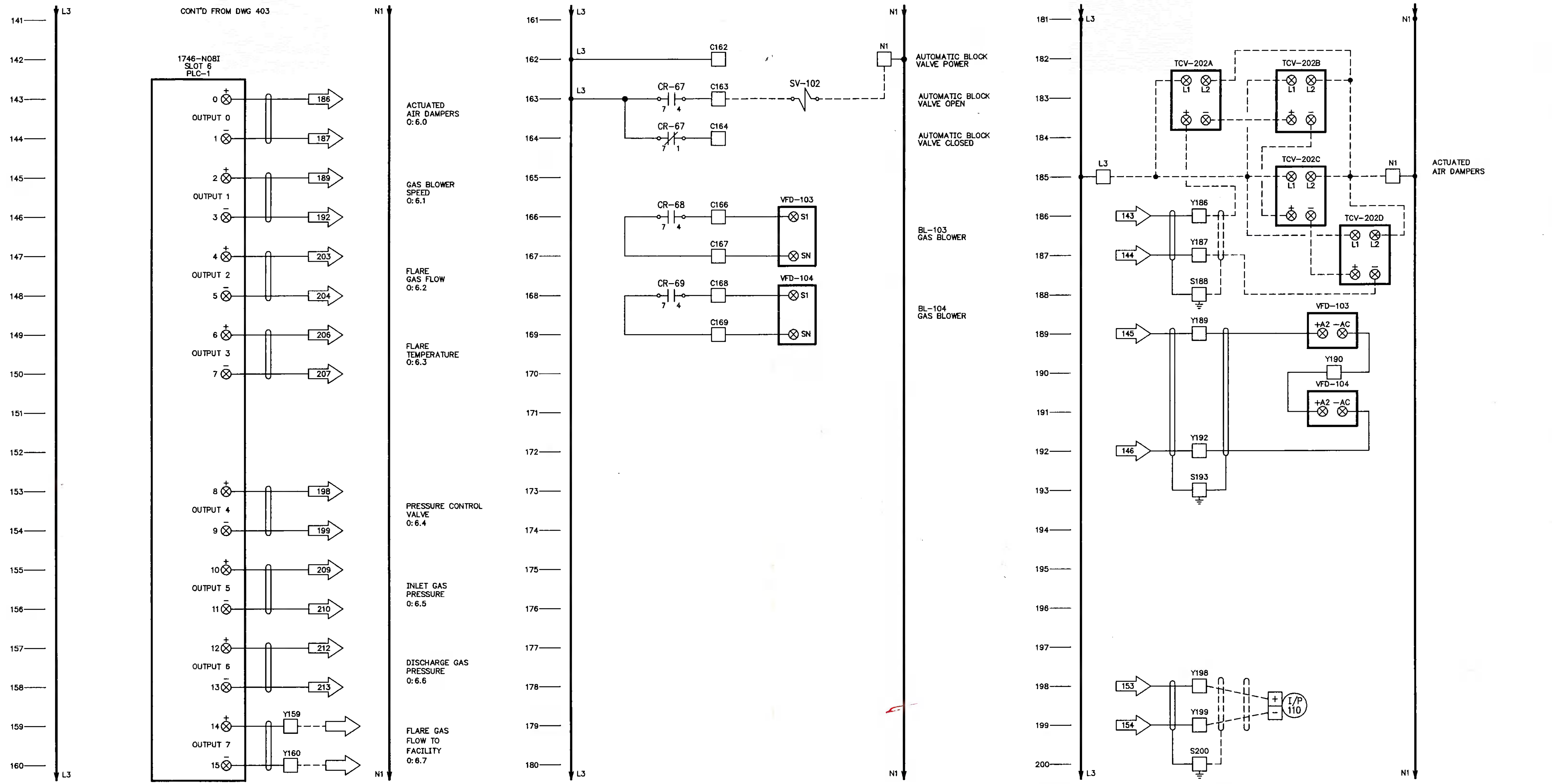


CONT'D ON DWG 404

FOR: VEOLIA ENVIRONMENTAL SERVICES	JOHN ZINK
USER: ZION LANDFILL	JOHN ZINK COMPANY LLC
JOBSITE: ZION, ILLINOIS	PARTS AND SERVICE, CALL 1-800-755-4252 FAX (918) 234-1968
S.O. NO. BF-9062818	PNL-101 WIRING DIAGRAM
P.O. NO. BF-00059812	FOR AN ENCLOSED ZTOF FLARE SYSTEM
DR. BP DATE: 2/21/07	CERTIFIED
CK. SAM DATE: 2/23/07	DRAWING NUMBER B-F-9062818-403 REV. 0
APP. JPR DATE: 2/23/07	DATE: SCALE NONE 1 of 1

NO.	REVISION DESCRIPTION	BY	CK.	APP.	DATE

CONT'D FROM DWG 403



CONT'D ON DWG 405

NO.	REVISION DESCRIPTION	BY	CK.	APP.	DATE

FOR: VEOLIA ENVIRONMENTAL SERVICES
USER: ZION LANDFILL
JOBSITE: ZION, ILLINOIS
S.O. NO. BF-9062818
P.O. NO. BF-00059812

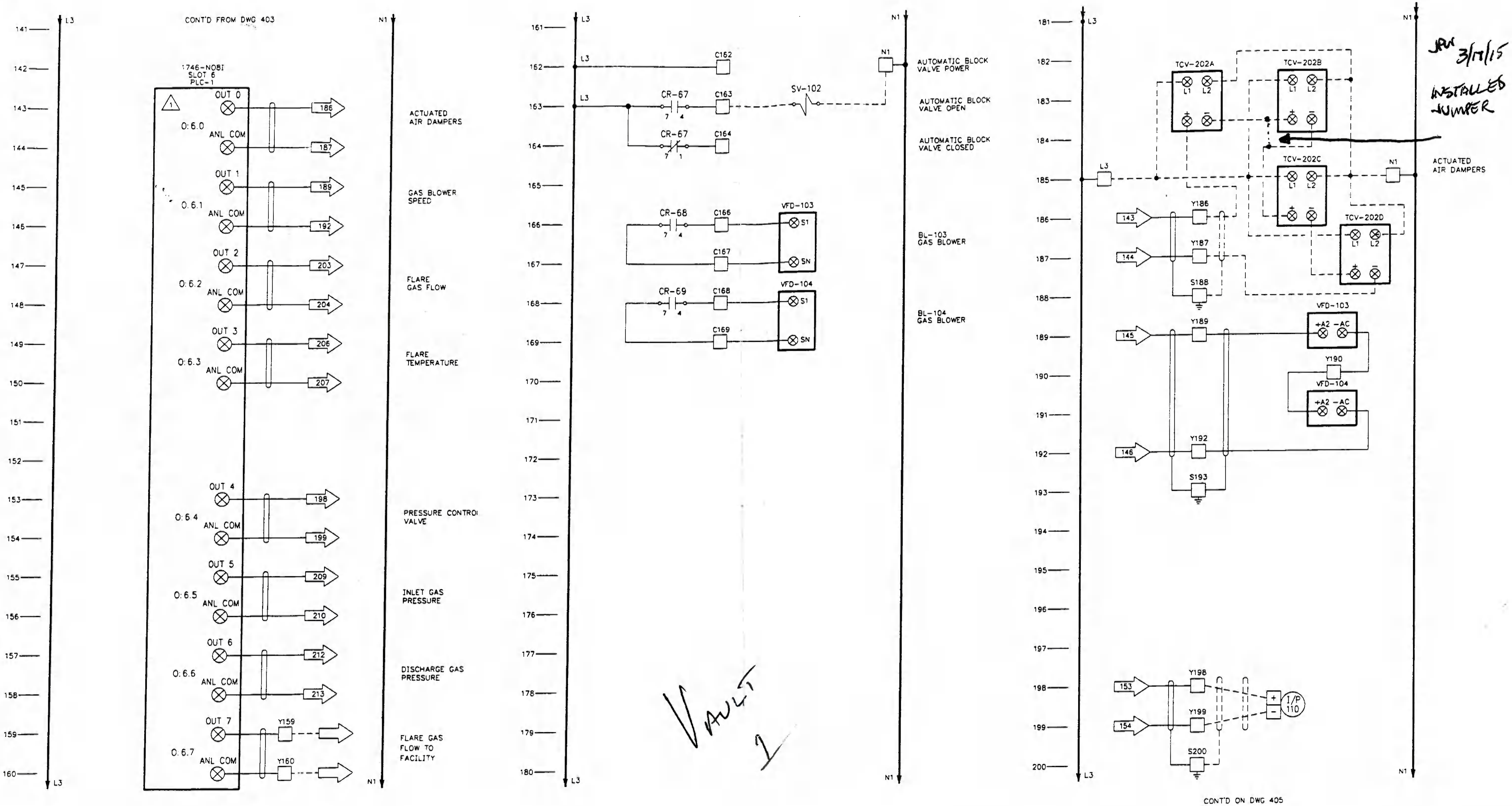
DR.	BP	DATE: 2/21/07
CK.	SAM	DATE: 2/23/07
APP.	JPR	DATE: 2/23/07

JOHN ZINK
JOHN ZINK COMPANY LLC
PARTS AND SERVICE, CALL 1-800-755-4252 FAX (918) 234-1968

PNL-101 WIRING DIAGRAM
FOR AN ENCLOSED ZTOF FLARE SYSTEM

CERTIFIED
DATE:

DRAWING NUMBER B-F-9062818-404 | REV. 0
SCALE NONE | 1 of 1



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FOR VEOLIA ENVIRONMENTAL SERVICES
USER: ZION LANDFILL
JOBSITE: ZION, ILLINOIS
J.O. NO. BF-9062818
P.O. NO. BF-00059812

DR.	BF	DATE 2/21/07		
CK.	SAM	DATE 2/23/07		
APP	JPR	DATE 2/23/07		

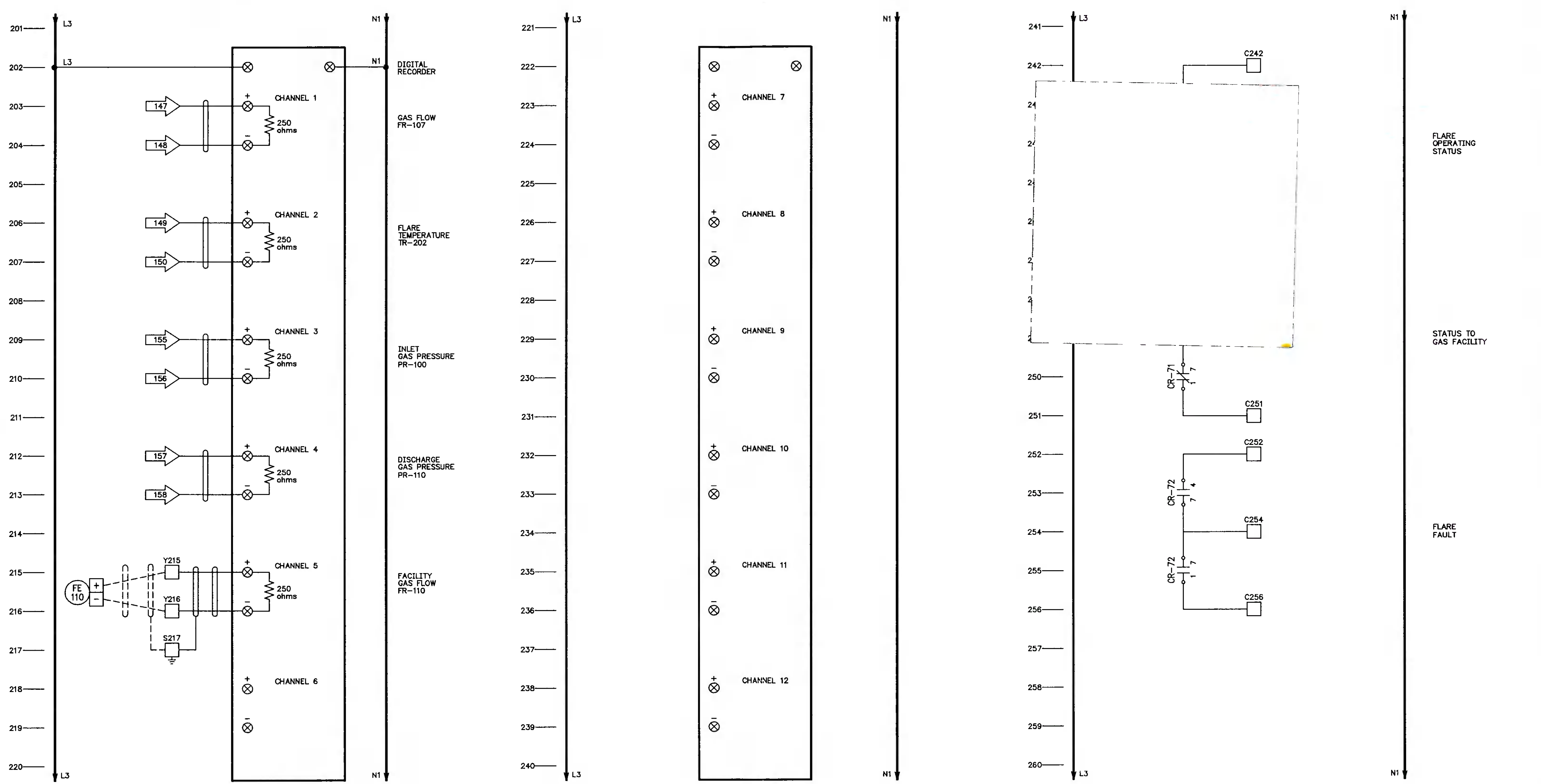
1	REVISED PER FABRICATION	RPJ	JPR	JPR
		BY	CK	APP

JOHN ZINK
JOHN ZINK COMPANY LLC
PARTS AND SERVICE, CALL 1-800-755-4252 FAX (918) 234-1959

PNL-101 WIRING DIAGRAM
FOR AN ENCLOSED ZTOF FLARE SYSTEM

CERTIFIED
SCALE NONE
DRAWING NUMBER B-F-9062818-404
REV. 1
1 of 1

CONT'D FROM DWG 404



NO.	REVISION DESCRIPTION	BY	CK.	APP.	DATE

FOR: VEOLIA ENVIRONMENTAL SERVICES
USER: ZION LANDFILL
JOBSITE: ZION, ILLINOIS
S.O. NO. BF-9062818
P.O. NO. BF-00059812

JOHN ZINK
JOHN ZINK COMPANY LLC
PARTS AND SERVICE, CALL 1-800-755-4252 FAX (918) 234-1968

PNL-101 WIRING DIAGRAM
FOR AN ENCLOSED ZTOF FLARE SYSTEM

DR.	BP	DATE: 2/21/07
CK.	SAM	DATE: 2/23/07
APP.	JPR	DATE: 2/23/07

CERTIFIED
DATE:

DRAWING NUMBER B-F-9062818-405 | REV. 0
SCALE
1 of 1

V. DESIGN BASIS

Gas Stream

Type:	landfill
Composition:	55% CH_4 (maximum)
	45% CO_2, air, inert gases
Lower Heating Value:	501 BTU/SCF
Temperature:	100 °F
Molecular Weight:	29
Flow Rate:	6000 SCFM (maximum)
	600 SCFM (minimum)
Heat Release *:	180,000,000 BTU/hr (maximum)

* lower heating value basis

CAUTION

Flame flashback may occur if the gas stream contains an amount of oxygen within the explosive limit.

NOTE

Methane concentrations less than 30% may require the addition of enrichment fuel for stable combustion.

Process Design

Smokeless Capacity:	100%
Destruction Efficiency:	98% (minimum)
Operating Temperature:	1400 °F to 1800 °F (2000 °F shutdown)
Retention Time:	0.7 second at 1800 °F (minimum)
Flare Inlet Pressure:	5" H_2O (maximum)
Ambient Pressure:	14.4 psia

Mechanical Design

Wind Speed Classification:	110 mph
Seismic Classification:	zone 4
Ambient Temperature:	32 to 120 °F
Electrical Area Classification:	non-hazardous
Site Elevation:	750' above sea level

Blower Design

Quantity:	two
Capacity:	3000 SCFM each (maximum)
Horsepower:	150 HP
Pressure Differential:	-100" H_2O suction
	2.50 psig discharge

Utility Requirements

Pilot Gas:	22 SCFH of propane at 10 psig 45 SCFH of natural gas at 15 psig
Compressed Air or Nitrogen:	100 psig (minimum) dry
Electrical:	480 V, three phase, 60 Hz for gas blower control 120 V, single phase, 60 Hz for control components

Shaw® LFG Specialties, L.L.C.

16406 US ROUTE 224 E
FINDLAY, OH 45840-9761
PHONE: (800) 225-6464 or (419) 424-4999
FAX: (419) 424-4997 or (419) 424-4991

LANDFILL GAS UTILITY FLARE #PCFT1242I10 RENTAL UNIT

LEGEND

INSTRUMENT OR FUNCTION SYMBOLS

LOCALLY MOUNTED	PANEL MOUNTED FRONT	PANEL MOUNTED BACK	
TAG NO	TAG NO	TAG NO	INSTRUMENT
TAG NO	TAG NO	TAG NO	SHARED DISPLAY, SHARED CONTROL
TAG NO	TAG NO	TAG NO	COMPUTER FUNCTION
TAG NO	TAG NO	TAG NO	PLC CONTROL

R RESET
P PURGE
I INTERLOCK
TAG NO TAG NO INSTRUMENTS SHARING COMMON HOUSING
ALARM HORN
INDICATING LIGHT
NO NOZZLE SCHEDULE POINT
NO DESIGN PARAMETER SCHEDULE POINT
NO SAMPLE SCHEDULE POINT

PIPING & INSTRUMENT LINE SYMBOLS

- FLOW DIRECTION
- MAIN FLOW
- SECONDARY FLOW
- PNEUMATIC SIGNAL
- ELECTRIC SIGNAL
- HYDRAULIC SIGNAL
- CAPILLARY TUBING
- ELECTROMAGNETIC (GUIDED)
- BOUNDARY
- SUPPLIED BY OTHERS

ELECTRICAL SCHEMATICS

- SIGNALS CONNECTED
- SIGNALS NOT CONNECTED

VALVES, REGULATORS, AND OTHER DEVICES

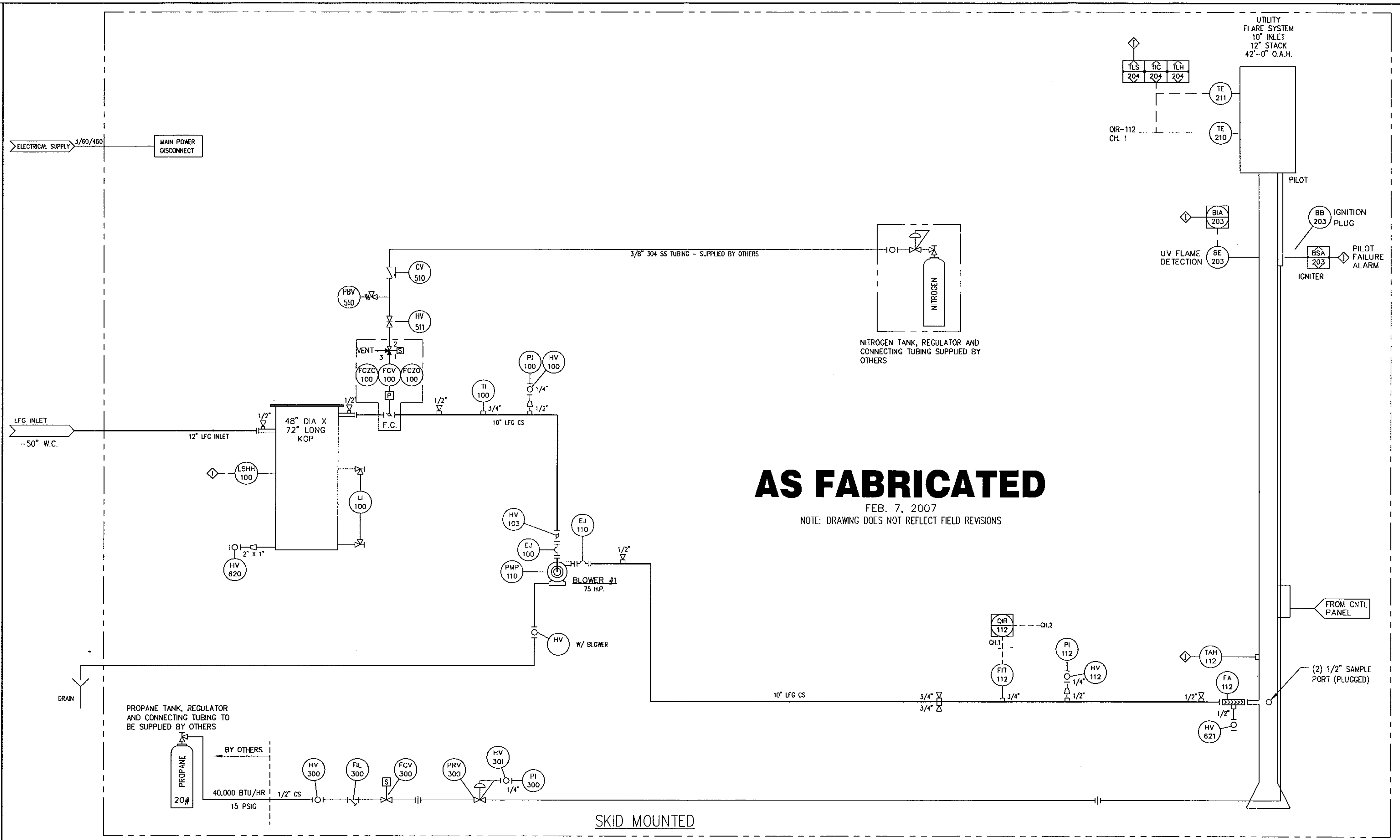
- GATE VALVE
- ANGLE VALVE
- BALL VALVE
- GLOBE VALVE
- BUTTERFLY VALVE
- CHECK VALVE
- THREE WAY VALVE
- PLUG VALVE
- NEEDLE VALVE
- MANUALLY OPERATED VALVE
- SOLENOID OPERATED VALVE
- PNEUMATICALLY OPERATED VALVE
- ELECTRIC MOTOR OPERATED VALVE
- DIAPHRAGM OPERATED VALVE
- PRESSURE RELIEF VALVE
- PRESSURE REDUCING REGULATOR
- PRESSURE REDUCING REGULATOR (SELF CONTAINED)
- BACK PRESSURE REGULATOR (SELF CONTAINED)
- FLANGED CONNECTION
- FLEXIBLE CONNECTION
- INSULATION
- REDUCER
- VENTURI TUBE
- FLOW STRAIGHTENER
- ORIFICE PLATE
- UNION
- STRAINER
- FLAME ARRESTER
- DAMPER (AUTOMATED)
- BLOWER OR PUMP

TABLE OF STANDARD IDENTIFICATION LETTERS

	FIRST LETTER	SECOND LETTER	THIRD LETTER	FOURTH LETTER
A	ANALYSIS	ALARM	ALARM	
B	BURNER, COMBUSTION	USER'S CHOICE		
C	CONNECTION, USER'S CHOICE	CONTROL	CONTROL	CLOSED
D	DIFFERENTIAL	DIFFERENTIAL		
E	VOLTAGE	SENSOR	SENSOR	
F	FLOW RATE	USER'S CHOICE		
G	GAUGE	GLASS, VIEWING DEVICE		
H	HAND	USER'S CHOICE	HIGH	HIGH
I	CURRENT (ELECTRICAL)	INDICATOR		
J	POWER	USER'S CHOICE		
K	TIME	CONTROL STATION		
L	LEVEL	LIGHT	LOW	LOW
M	USER'S CHOICE, MECHANICAL	USER'S CHOICE, DELIVERY		
N	USER'S CHOICE, REMOTE	USER'S CHOICE		
O	USER'S CHOICE	ORIFICE, RESTRICTION		OPEN
P	PRESSURE, VACUUM	POINT (TEST) CONNECTION	DEVICE, BLOWER	
Q	QUANTITY	INTEGRATE, TOTALIZE		
R	RADIATION	RECORDER		
S	SPEED, FREQUENCY	SAFETY	SWITCH	SWITCH
T	TEMPERATURE	TRANSMIT		
U	MULTIVARIABLE	MULTIFUNCTION	MULTIFUNCTION	MULTIFUNCTION
V	VIBRATION	VALVE, DAMPER, LOUVER	VALVE, DAMPER, LOUVER	
W	WEIGHT, FORCE	WELL		
X	UNCLASSIFIED	X AXIS, EXCHANGER, SEPERATOR	UNCLASSIFIED	UNCLASSIFIED
Y	EVENT, STATE	Y AXIS	RELAY, COMPUTE, CONVERT	
Z	POSITION, DIMENSION	Z AXIS	DRIVER, ACTUATE	

ABBREVIATIONS

AS	AIR SUPPLY
COND	CONDENSATE
CPLG	COUPLING
CS	CARBON STEEL
ES	ELECTRICAL SUPPLY
ESD	EMERGENCY SHUT DOWN
GS	GAS SUPPLY
HDPE	HIGH DENSITY POLYETHYLENE
IAS	INSTRUMENT AIR SUPPLY
KOP	KNOCK-OUT TANK
LFG	LANDFILL GAS
MCC	MOTOR CONTROL CENTER
MS	MOTOR STARTER
PS	PIPE STAND/SUPPORT
PVC	POLYVINYL CHLORIDE
SC	SAMPLE CONNECTION
SS	STAINLESS STEEL
WS	WATER SUPPLY



Shaw® LFG Specialties, L.L.C.

REV	DESCRIPTION / ISSUE	DATE	BY
1	AS FABRICATED	2/7/07	CLK
0	RELEASED FOR PURCHASING	9/27/06	CLK

PIPING AND INSTRUMENTATION DIAGRAM

DRAWN BY: CLK | ENGINEER: RS | APPROVED BY: RS | SIZE: D

SCALE: NONE | DATE: 9/27/06 | PROJECT NO: 110157

PROJECT NAME: LANDFILL GAS UTILITY FLARE #PCFT1242I10 RENTAL UNIT

CUSTOMER: LFG SPECIALTIES

SERIAL NO: 2065 | DWG NO: PID | SHT: 1

File: F:\LFG\2000 DRAWINGS\2065\MECHANICAL\2065-PID-SHT1.dwg Layout: Model User: randy.mcquillen Feb 08, 2007 - 9:23am

EQUIPMENT / INSTRUMENT LEGEND

SERVICE	ITEM	QTY	DESCRIPTION	SUPPLIER	PART NO.	ADDITIONAL INFORMATION
LFG	EJ-100	1	EXPANSION JONT 10" X 8" X 6" LG SOA JI BUNA W/ RING	LFG	VFJ10X8B	
LFG	FCV-100	1	10" PNEUMATIC BUTTERFLY VALVE	LFG	VWB10CT-POC	
NITROGEN	FCZO-100	1	POSITION SWITCH FCV-100 OPEN SUPPLIED W/ FCV-100			
NITROGEN	FCZC-100	1	POSITION SWITCH FCV-100 CLOSED SUPPLIED W/ FCV-100			
LFG	HV-100	1	1/4" GAGE VALVE SS THRD	LFG	PFGV014S	
COND.	LSHH-100	1	LIQUID LEVEL SWITCH HIGH HIGH	LFG	ECLS100X120	
LFG	LI-100	1	SIGHT GAGE POLY 5/8" OD x 1/2" ID (REFERENCE)	LFG		VISUAL
LFG	PI-100	1	INLET HEADER VACUUM GAUGE	LFG	PFG100-0H2OV	-100" TO 0" W.C.
LFG	TI-100	1	TEMPERATURE GAUGE	LFG	PFGT300600	0' TO 250' F
LFG	HV-103	1	12" MANUAL 70-1200-2SU4IB1	LFG	VWB12CB-M-G	
LFG	EJ-110	1	EXPANSION JONT 10" X 8" X 6" LG SOA JI BUNA W/ RING	LFG	VFJ10X8B	
LFG	PMP-110	1	LFG BLOWER	HSI	8602	3000 SCFM @ -50" W.C. INLET & 15" W.C. OUTLET, 75 H.P.
						3/60/460 TEFC MOTOR, BELT DRIVE, CW TH DISCHARGE
LFG	FA-112	1	FLAME ARRESTOR 10"	LFG	FA10AH-V	
LFG	FIT-112	1	GAS FLOW METER PROBE	FCI	ST-98	0 TO 3100 SCFM
LFG	HV-112	1	1/4" GAGE VALVE SS THRD	LFG	PFGV014S	
LFG	PI-112	1	OUTLET HEADER PRESSURE GAUGE	LFG	PFG025H2OP	0" - 25" W.C.
LFG	QIR-112	1	FLOW RECORDER	LFG	2065-ECB	4-20 mA
LFG	TAH-112	1	FLARE INLET HIGH TEMPERATURE ALARM	LFG	ESTB1X68	300' F
STACK	BB-203	1	IGNITION PLUG	LFG	ESPI64	
STACK	BE-203	1	ULTRAVIOLET FLAME SCANNER (REFERENCE ONLY)	LFG		
–	BIA-203	1	FLAME DETECTOR RELAY	LFG		10 SEC. DELAY MIN.
STACK	BSA-203	1	PILOT FAILURE ALARM			5 MIN.
STACK	TE-210	1	FLARE STACK LOWER THERMOCOUPLE	LFG	ETCA14W084SK	7'-0 LG., TYPE "K"
STACK	TE-211	1	FLARE STACK UPPER THERMOCOUPLE	LFG	ETCA14W096SK	8'-0 LG., TYPE "K"
STACK	TLS-211	1	BLOWER ON RELAY			300' F
STACK	TIC-211	1	PILOT TEMPERATURE CONTROLLER			
STACK	TLH-211	1	PILOT OFF RELAY FCV-300 CLOSED			400' F
PROPANE	HV-300	1	1/2" BALL VALVE	LFG	PFV012S	
PROPANE	FCV-300	1	PROPANE GAS SHUT-OFF SOLENOID VALVE	LFG	PFS012Y120VEXP	
PROPANE	FIL-300	1	Y-STRAINER W/ 1/4" SQUARE PLUG	LFG	PFY012C	
PROPANE	PI-300	1	PROPANE GAS PRESSURE INDICATOR	LFG	PFG212PSI15	0 TO 15 PSIG
PROPANE	PRV-300	1	PROPANE GAS PRESSURE REGULATOR	LFG	PFD012B	SET TO 3 PSIG
PROPANE	HV-301	1	BALL VALVE 1/4" SS	LFG	PFV014S	
NITROGEN	CV-510	1	VALVE BALL CHECK BRASS 3/4"	LFG	PFV014ZC	
NITROGEN	PBV-510	1	PRESSURE RELIEF VALVE	LFG	POPOFFVALVE	S.P.=125 PSIG
NITROGEN	HV-511	1	NEEDLE VALVE	LFG	PFV014NZ	
CONDENSATE	HV-620	1	1" BALL VALVE THRU-UNION PVC	LFG	PFV1P	
CONDENSATE	HV-621	1	1/2" BALL VALVE SS	LFG	PFV012S	

SHIP LOOSE LIST

ITEM	QTY	DESCRIPTION	SUPPLIER	PART NO.	INVENTORY AMOUNT
1	12	7/8-9 UNC HEX BOLT 4" LG GR8 W/ NUTS & 24 WASHERS	LFG	FLOOR STOCK	
2	1	GASKET F-F NON-ASBESTOS 12" (FOR KOP)	LFG	WFG12NA	
3	1	GASKET F-F NON-ASBESTOS 12" x 1/8" THK (FOR STACK)	LFG	USFG12	
4	1	CAN OF AEROSOL PAINT	LFG	MPSGAP-A	
5	1	UV EYE	LFG	EUVSCNRA	
6	1	SET OF KEYS FOR PANELS	LFG		
7	1	TUBE OF HI-TEMP RED SILICONE FOR UV EYE	LFG		
8	1	BEARING GREASE	LFG	GREASE-C	

AS FABRICATED

FEB. 7, 2007

NOTE: DRAWING DOES NOT REFLECT FIELD REVISIONS

Shaw® LFG Specialties, L.L.C.

REV	DESCRIPTION / ISSUE	DATE	BY
1	AS FABRICATED	2/7/07	CLK
0	RELEASED FOR PURCHASING	9/27/06	CLK

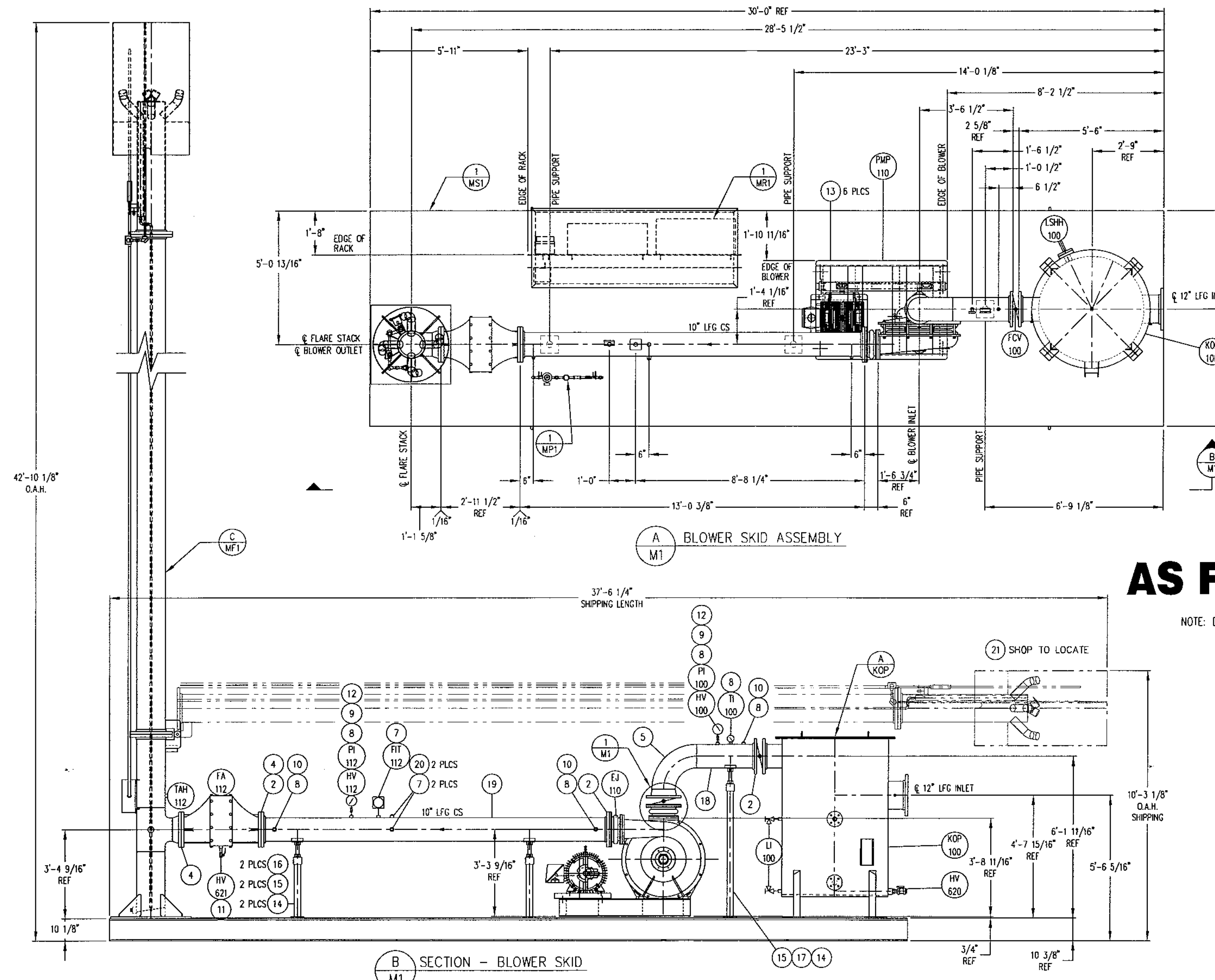
PIPING AND INSTRUMENTATION DIAGRAM

DRAWN BY: CLK | ENGINEER: RS | APPROVED BY: RS | SIZE: D

SCALE: NONE | DATE: 9/27/06 | PROJECT NO: 110157

PROJECT NAME: LANDFILL GAS UTILITY FLARE #PCFT1242I10 RENTAL UNIT

CUSTOMER: LFG SPECIALTIES | SERIAL NO: 2065 | DWG NO: PID | SHT: 2



SYSTEM TO BE ORIENTED WITH THE FLARE CONTROL PANEL FACING NORTH

N

AS FABRICATED

FEB. 7, 2007

NOTE: DRAWING DOES NOT REFLECT FIELD REVISIONS

NOTES:

1. ALL BOLTS, CAP SCREWS AND NUTS WILL BE SAE GRADE 8 WITH YELLOW ZINC DICHROMATE PLATING. THREADED RODS WILL STAINLESS STEEL. ALL THREADS WILL BE UNIFIED NATIONAL COARSE.
2. ALL 1/8"-1 1/2" PIPES WILL BE STANDARD BLACK PIPE ASTM A53 OR ASTM A106. ALL 1/8"-1 1/2" PIPE NIPPLES WILL BE STANDARD BLACK PIPE ASTM A733. 3. ALL 1/8"-1 1/2" PIPE FITTINGS (ELBOWS, TEES, BUSHINGS & ETC.) WILL BE STANDARD (CLASS 150) WITH A BLACK FINISH.
3. EXTERNAL PIPE SURFACES TO BE BLASTED TO SP-7 SPECIFICATIONS, APPLIES TO CARBON STEEL PIPING ONLY.
4. ALL CARBON STEEL VESSELS AND PIPE EXTERNALS TO BE COATED WITH RUST PROHIBITING SHERWIN WILLIAMS B67R5 RED OXIDE RECOATABLE PRIMER AND FINISHED WITH A 3 MIL COAT OF SLATE GREY COLORED INDUSTRIAL ACRYLIC POLYURETHANE, SHERWIN WILLIAMS ACROLON 218 HS.
5. FLARE STACK TO BE COATED WITH A 6 MIL COAT OF AMERON DIMETCOTE 25-1.
6. INSTALL GAUGES TO FACE CONTROL RACK SIDE.
7. ALL PIPE BUTT WELD JOINTS WILL HAVE A 1/8" ROOT OPENING.
8. A MINIMUM DISTANCE FROM POWER LINES AND STRUCTURES OF 4 TIMES THE STACK HEIGHT MUST BE MAINTAINED AROUND THE FLARE.

Shaw® LFG Specialties, L.L.C.

REV	DESCRIPTION / ISSUE	DATE	BY
1	AS FABRICATED	2/7/07	CLK
0	RELEASED FOR PURCHASING	9/27/06	CLK

BLOWER SKID ASSEMBLY

DRAWN BY:	ENGINEER:	APPROVED BY:	SIZE:
CLK	RS	RS	D
SCALE:	DATE:	PROJECT NO:	
1/2" = 1'-0"	9/27/06	110157	

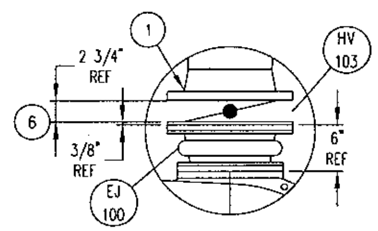
PROJECT NAME: LANDFILL GAS UTILITY FLARE #PCF1242110 RENTAL UNIT

CUSTOMER	SERIAL NO:	DWG NO:	SHT:
LFG SPECIALTIES	2065	M1	1

File: F:\LFG\2000 DRAWINGS\2065\MECHANICAL\2065-M1-SHT1.dwg Layout: Model User: randy.mcquillen Feb 08, 2007 - 9:24am

BILL OF MATERIAL

ITEM	QTY	DESCRIPTION	SUPPLIER	PART NO.	INVENTORY AMOUNT
1	1	FLANGE RFWN CS 150# 10"	LFG	WFW1000B3	
2	3	FLANGE RFSO CS 150# 10"	LFG	WFF10B3	
3					
4	2	GASKET F-F NON-ASBESTOS 10"	LFG	WFG10NA	
5	1	ELL 90° LR CS 10"	LFG	WFL10B4	
6	1	BACKING RING SS 10"	LFG	VFJBR1038S	
7	3	HALF COUPLING CS 3/4"	LFG	FLOOR STOCK	
8	6	HALF COUPLING CS 1/2"	LFG	FLOOR STOCK	
9	2	REDUCER SS 1/2" x 1/4" THRD	LFG	FLOOR STOCK	
10	3	PLUG SS 1/2"	LFG	FLOOR STOCK	
11	1	PIPE NIPPLE SS 1/2" x 3" LG	LFG	FLOOR STOCK	
12	2	PIPE NIPPLE SS 1/4" x 2" LG	LFG	FLOOR STOCK	
13	6	VIBRATION PAD	LFG	VP35DUROMETER	
14	3	PIPE SUPPORT ASSEMBLY 10"	LFG	PIPESUPPORT10	
15	3	PIPE SUPPORT BASE	LFG	PIPESUPPORTBASE	
16	2	PIPE BLK SCH40 2"	LFG	PW2B40	2.3
17	1	PIPE BLK SCH40 2"	LFG	PW2B40	5.0
18	1	PIPE SCH40 CS 10"	LFG	PW10B40	2.3
19	1	PIPE SCH40 CS 10"	LFG	PW10B40	13.0
20	2	PLUG SS 3/4"	LFG	FLOOR STOCK	



1/M1 DETAIL - BLOWER INLET
SCALE: 2X

AS FABRICATED

FEB. 7, 2007

NOTE: DRAWING DOES NOT REFLECT FIELD REVISIONS

Shaw® LFG Specialties, L.L.C.

REV	DESCRIPTION / ISSUE	DATE	BY
1	AS FABRICATED	2/7/07	CLK
0	RELEASED FOR PURCHASING	9/27/06	CLK

BLOWER SKID ASSEMBLY

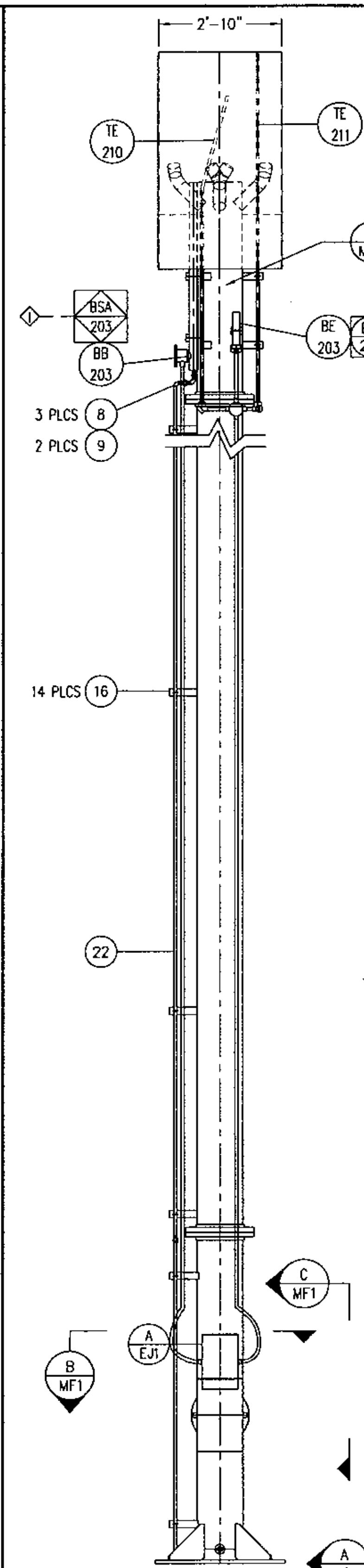
DRAWN BY:	ENGINEER:	APPROVED BY:	SIZE:
CLK	RS	RS	D

SCALE	DATE:	PROJECT NO:
1/2" = 1'-0"	9/27/06	110157

PROJECT NAME: LANDFILL GAS UTILITY FLARE #PCF1242I10 RENTAL UNIT

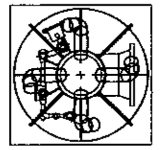
CUSTOMER	SERIAL NO:	DWG NO:	SHT:
LFG SPECIALTIES	2065	M1	2

File: F:\LFG\2000 DRAWINGS\2065\MECHANICAL\2065-M1-SHT2.dwg Layout: Model User: randy.mcquillen Feb 08, 2007 - 9:25am



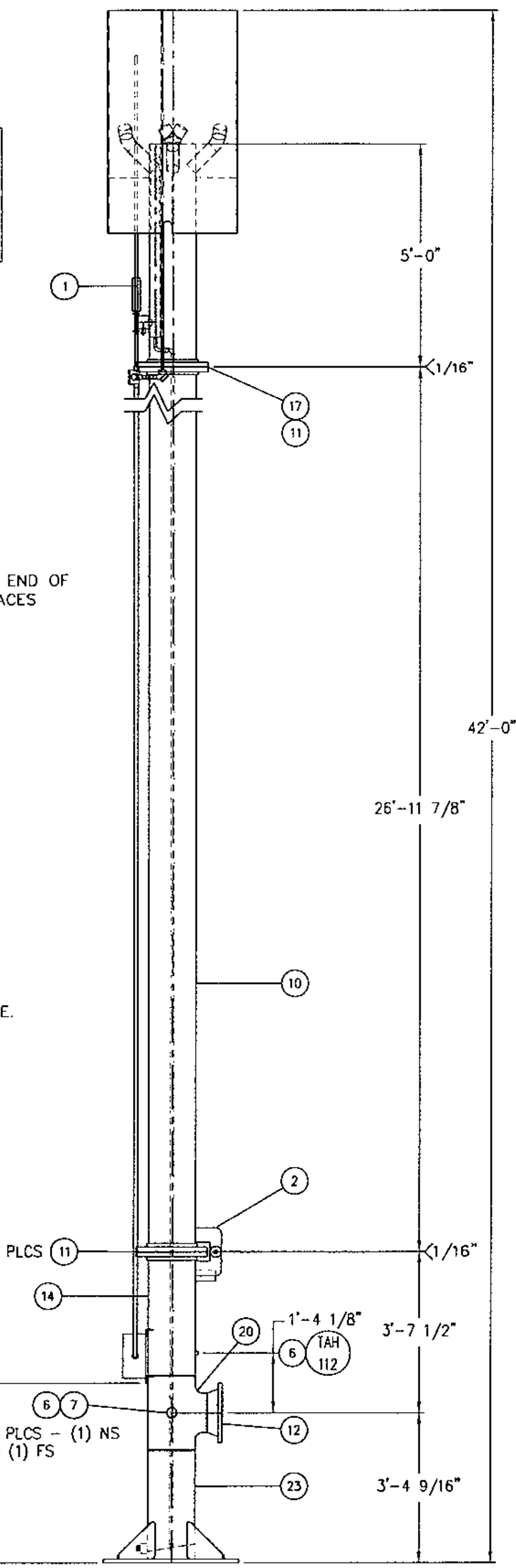
C/M1 SECTION – STACK ASSEMBLY

UTILITY
FLARE SYSTEM
10" INLET
12" STACK
42'-0" O.A.H



NOTE:
SPACE ITEM #16 6" FROM EACH END OF PROPANE LINE – TYPICAL 4 PLACES

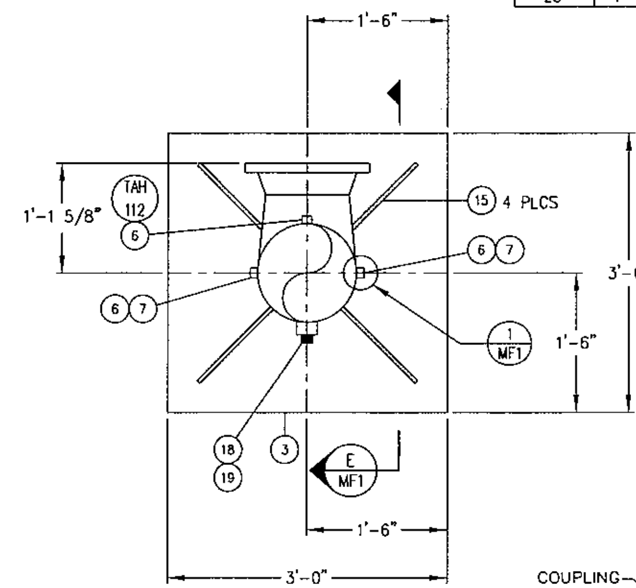
NOTE:
INTERNAL PIPE AND FITTINGS TO BE COATED WITH EPOXY FROM TOP WELD OF TEE TO BASE.



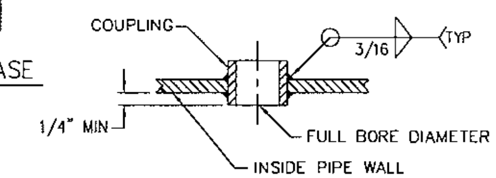
A/MF1 SECTION – STACK ASSEMBLY

BILL OF MATERIAL

ITEM	QTY	DESCRIPTION	SUPPLIER	PART NO.	INVENTORY AMOUNT
1	1	UTILITY FLARE IGNITOR ASSEMBLY	LFG	CFIGNASY52	
2	1	HINGE BRACKET 10"/12"FLG SIZE	LFG	MH10/12ASSY	
3	1	PLATE FB A36 36X 36X 3/4"	LFG	BP3636034	
4					
5					
6	3	HALF COUPLING CS 1/2"	LFG	FLOOR STOCK	
7	2	PLUG SS 1/2"	LFG	FLOOR STOCK	
8	3	90° ELL CS THRD 1/2"	LFG	FLOOR STOCK	
9	2	UNION CS THRD 1/2"	LFG	FLOOR STOCK	
10	1	PIPE BLK A53B ERW SCH40 12"	LFG	PW12B40	26.9
11	3	12" 150# RFSO FLANGE	LFG	WFF12B3	
12	1	10" 150# RFWN FLANGE	LFG	WFW1000B3	
13	1	STACK FALSE BOTTOM 12"	LFG	STACKFALSEBTM-12	
14	1	PIPE BLK A53B ERW SCH40 12"	LFG	PW12B40	1.1
15	4	FLARE GUSSET	LFG	SPFLRGUS12	
16	14	CONDUIT TABS	LFG	STACKCONDTABCS	
17	1	12" NON-ASBESTOS GASKET	LFG	WFG12NA	
18	1	2" SS HALF COUPLING	LFG	FLOOR STOCK	
19	1	2" PIPE PLUG	LFG	FLOOR STOCK	
20	1	TEE REDUCING WELD CS SCH 40 12 X 10	LFG	WFZ12X10B3	
21	2	JUNCTION BOX BRACKET	LFG	JBOXBRKT12	
22	1	PIPE BLK STD WT 1/2"	LFG	PW012B40	35.0
23	1	PIPE BLK A53B ERW SCH40 12"	LFG	PW12B40	4.2



B/MF1 SECTION – STACK BASE
SCALE: 2x



1/MF1 DETAIL – COUPLING
SCALE: NONE
3 PLACES

NOTES:

1. ALL BOLTS, CAP SCREWS AND NUTS WILL BE SAE GRADE 8 WITH YELLOW ZINC DICHROMATE PLATING. THREADED RODS WILL BE LOW CARBON STEEL WITH YELLOW ZINC DICHROMATE PLATING. ALL THREADS WILL BE UNIFIED NATIONAL COARSE.

2. ALL 1/8"–1 1/2" PIPES WILL BE STANDARD BLACK PIPE ASTM A53 OR ASTM A106. ALL 1/8"–1 1/2" PIPE NIPPLES WILL BE STANDARD BLACK PIPE ASTM A733. 3. ALL 1/8"–1 1/2" PIPE FITTINGS (ELBOWS, TEES, BUSHINGS & ETC.) WILL BE STANDARD (CLASS 150) WITH A BLACK FINISH.

4. EXTERNAL PIPE SURFACES TO BE BLASTED TO SP-7 SPECIFICATIONS. APPLIES TO CARBON STEEL PIPING ONLY.

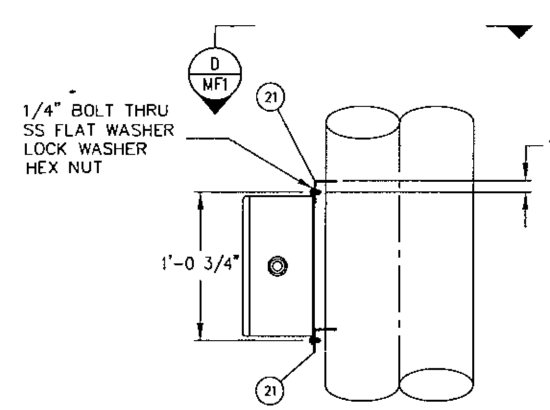
5. C.S. PIPE EXTERNAL SURFACES TO BE COATED WITH RUST PROHIBITING SHERWIN WILLIAMS B67R5 RED OXIDE RECOATABLE PRIMER AND FINISHED WITH A 3 MIL COAT OF SLATE GREY COLORED INDUSTRIAL ACRYLIC POLYURETHANE, SHERWIN WILLIAMS ACROLON 218 HS.

6. PIPE INTERNAL SURFACES TO BE BLASTED TO SP-7 SPECIFICATIONS. PIPE INTERNALS FROM TOP OF THE TEE TO THE BASE OF THE FLARE WILL BE COATED WITH SHERWIN WILLAMS PHENICON HS FLAKE FILLED SOLID EPOXY.

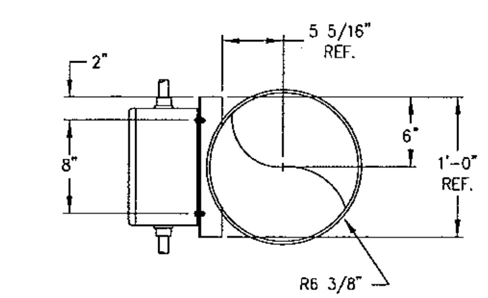
7. ALL PIPE BUTT WELD JOINTS WILL HAVE A 1/8" ROOT OPENING.

8. A MINIMUM DISTANCE FROM POWER LINES AND STRUCTURES OF 4 TIMES THE STACK HEIGHT MUST BE MAINTAINED AROUND THE FLARE. IF THIS DISTANCE IS NOT FEASIBLE, PLEASE CONTACT LFG SPECIALTIES ENGINEERING.

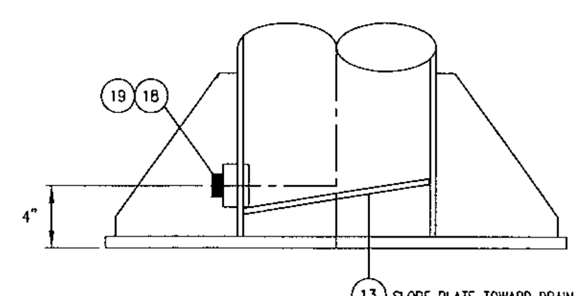
AS FABRICATED
FEB. 7, 2007
NOTE: DRAWING DOES NOT REFLECT FIELD REVISIONS



C/MF1 SECTION – JUNCTION BOX ASSEMBLY
SCALE: 3x



D/MF1 SECTION – JUNCTION BOX ASSEMBLY
SCALE: 3x



E/MF1 SECTION – STACK BASE
SCALE: 4x

Shaw® LFG Specialties, L.L.C.

REV	DESCRIPTION / ISSUE	DATE	BY
1	AS FABRICATED	2/7/07	CLK
0	RELEASED FOR PURCHASING	9/28/06	CLK

UTILITY FLARE ASSEMBLY

DRAWN BY:	ENGINEER:	APPROVED BY:	SIZE:
CLK	RS	RS	D

SCALE	DATE:	PROJECT NO:
1/2" = 1'-0"	9/28/06	110157

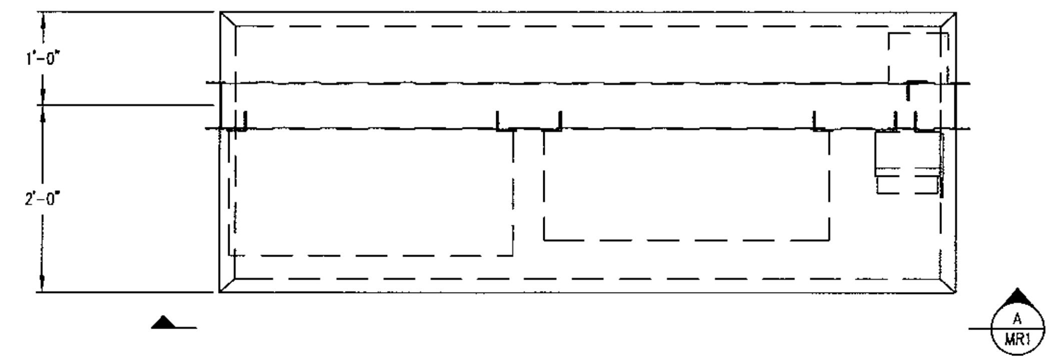
PROJECT NAME: LANDFILL GAS UTILITY FLARE #PCFT1242I10 RENTAL UNIT

CUSTOMER	SERIAL NO:	DWG NO:	SHT:
LFG SPECIALTIES	2065	MF1	1

File: F:\LFG\2000 DRAWINGS\2065\MECHANICAL\2065-MF1.dwg Layout: Model User: randy.mcquillen Feb 08, 2007 – 9:25am

BILL OF MATERIAL

ITEM	QTY	DESCRIPTION	SUPPLIER	PART NO.	INVENTORY AMOUNT
1	1	ANGLE 4" X 3" X 1/4"	LFG	SA4X3X14	.5
2	1	TRANSFORMER STRAP	LFG	3KVABRK	
3	6	RACK MOUNTING ANGLE	LFG	RACKMTGANGLE	
4	1	TRANSFORMER MOUNTING ANGLE	LFG	TRANSANGLE	
5	2	RACK GUSSET	LFG	RACKGUS3X38	
6	1	RACK ASSEMBLY DETAIL	LFG	RACK8	
7	1	RACK ROOF ASSEMBLY	LFG	MINIROOF8	



1/M1 ELECTRICAL CONTROL RACK ASSEMBLY

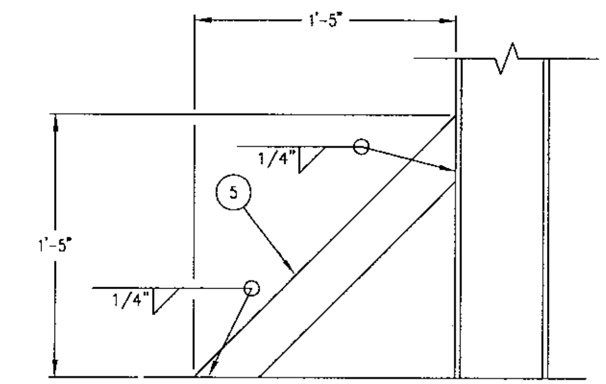
NOTES:

1. ALL BOLTS, CAP SCREWS AND NUTS WILL BE SAE GRADE 8 WITH YELLOW ZINC DICHROMATE PLATING. THREADED RODS WILL BE LOW CARBON STEEL WITH YELLOW ZINC DICHROMATE PLATING. ALL THREADS WILL BE UNIFIED NATIONAL COARSE.
2. ALL SURFACES TO BE BLASTED TO SP-7 SPECIFICATIONS.
3. ALL SURFACES TO BE COATED WITH RUST PROHIBITING SHERWIN WILLIAMS B67R5 RED OXIDE RECOATABLE PRIMER AND FINISHED WITH A 3 MIL COAT OF SLATE GREY COLORED INDUSTRIAL ACRYLIC POLYURETHANE, SHERWIN WILLIAMS ACROLON 218 HS.
4. ALL WELD JOINTS WILL HAVE A 1/8" MAX ROOT OPENING.
5. ALL MATERIAL IS LOW CARBON STEEL UNLESS OTHERWISE SPECIFIED.
6. TOLERANCE +/-1/8" ON STEEL CUT LENGTH, UNLESS OTHERWISE SPECIFIED.

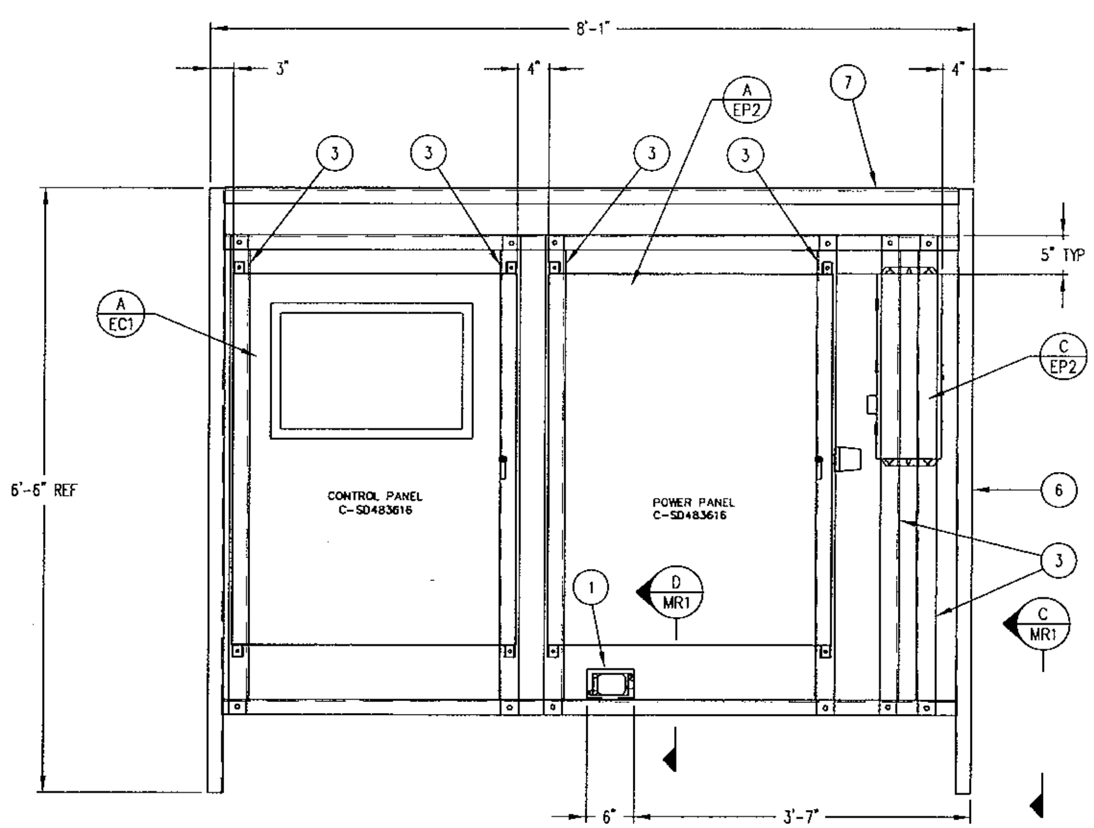
NOTE:
DIMENSIONS ARE TO FACE OF ELECTRICAL BOXES

AS FABRICATED

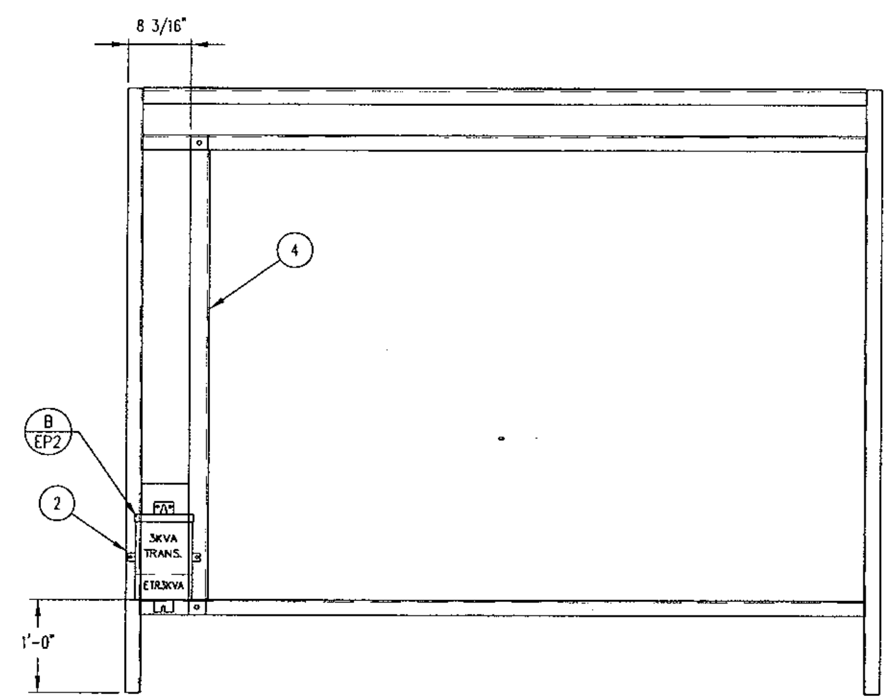
FEB. 7, 2007
NOTE: DRAWING DOES NOT REFLECT FIELD REVISIONS



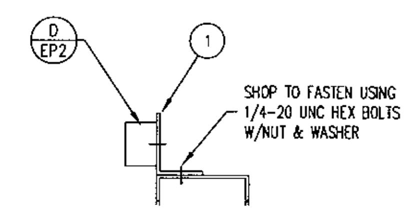
C/MR1 SECTION - BRACE
SCALE: 2X
TYP. 2 PLACES



A/MR1 SECTION - RACK



B/MR1 SECTION - RACK



D/MR1 SECTION - RECEPTACLE

Shaw® LFG Specialties, L.L.C.

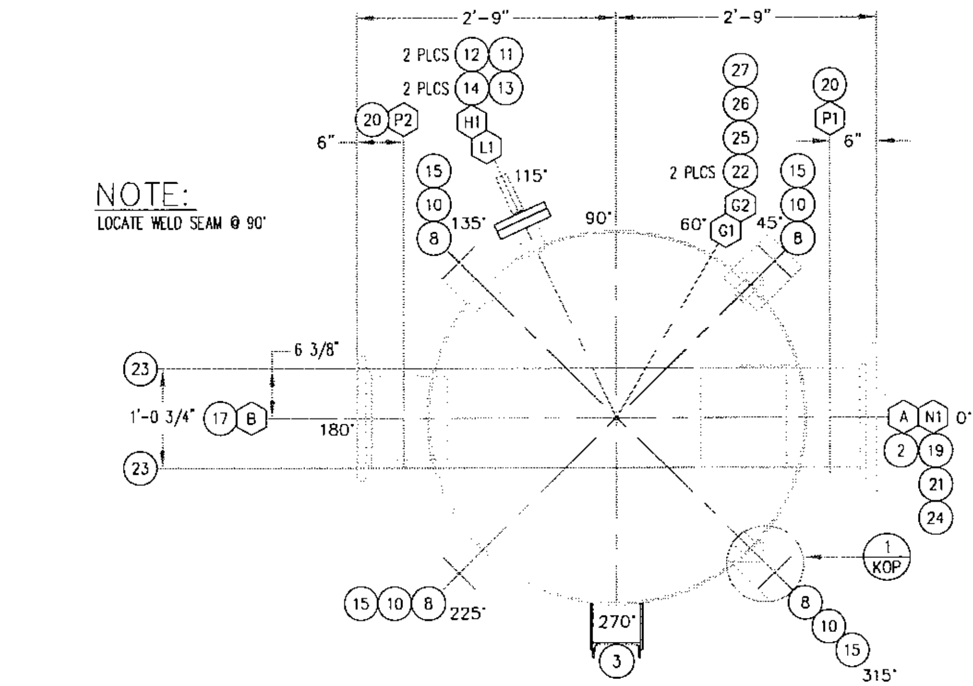
REV	DESCRIPTION / ISSUE	DATE	BY
1	AS FABRICATED	2/7/07	CLK
0	RELEASED FOR PURCHASING	9/28/06	CLK

ELECTRICAL CONTROL RACK ASSEMBLY

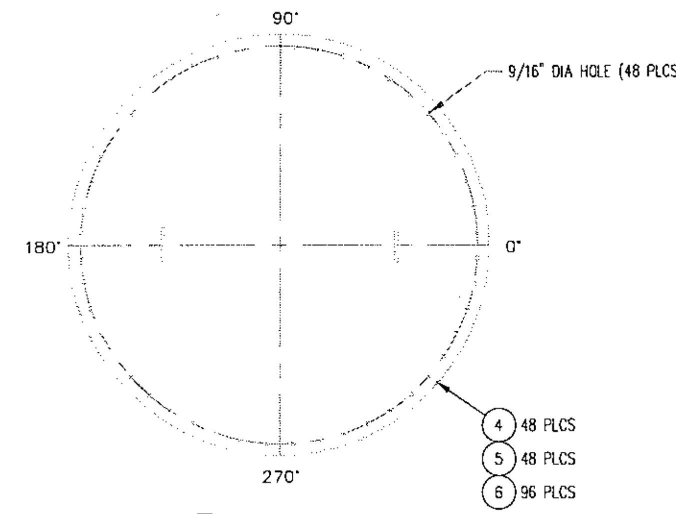
DRAWN BY: CLK | ENGINEER: RS | APPROVED BY: RS | SIZE: D
SCALE: 1"=1'-0" | DATE: 9/28/06 | PROJECT NO: 110157

PROJECT NAME: LANDFILL GAS UTILITY FLARE #PCFT1242I10 RENTAL UNIT

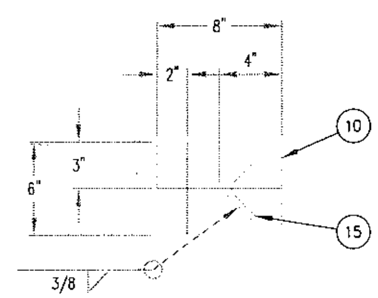
CUSTOMER: LFG SPECIALTIES | SERIAL NO: 2065 | DWG NO: MR1 | SHT: 1



B KOP PLAN – NOZZLE ORIENTATION

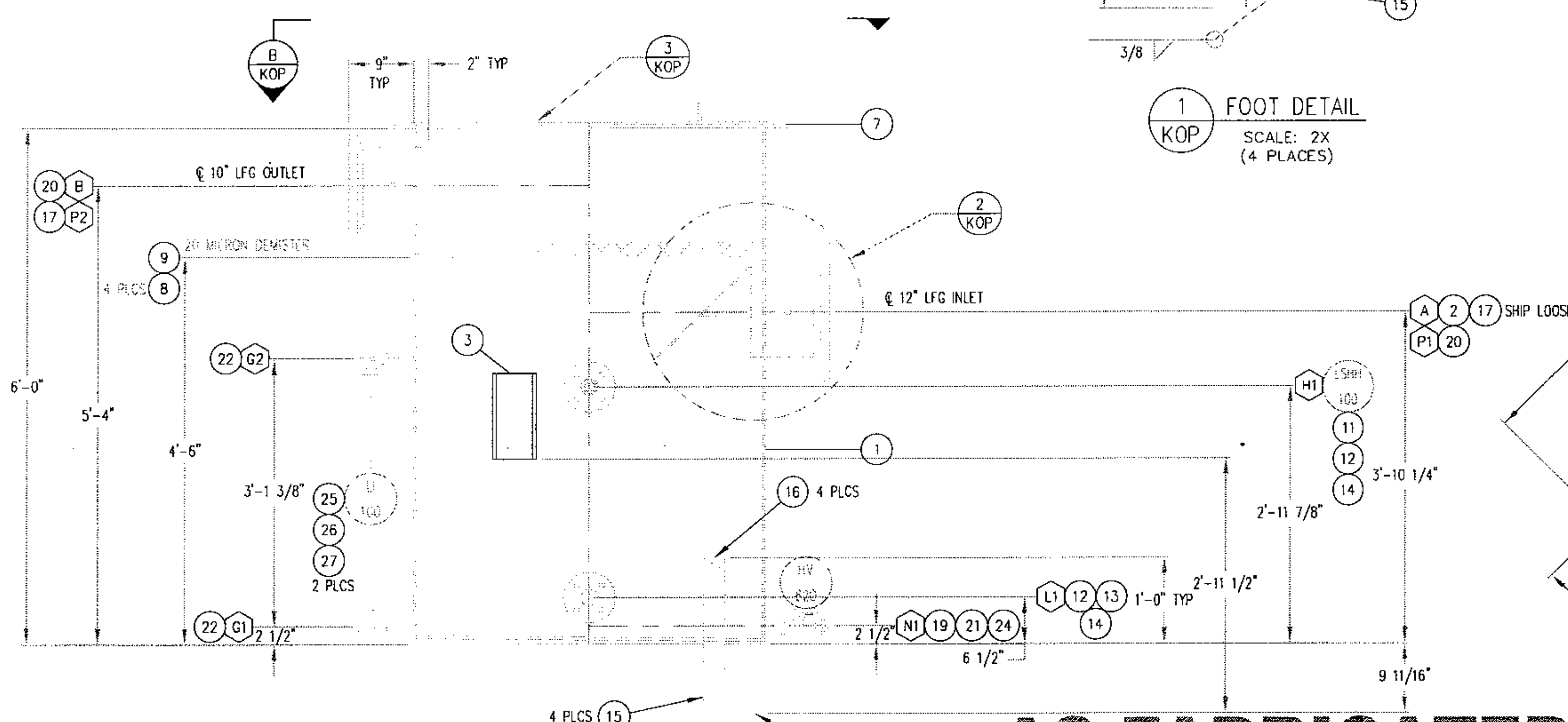


3 KOP LID DETAIL



1 KOP FOOT DETAIL

SCALE: 2X
(4 PLACES)

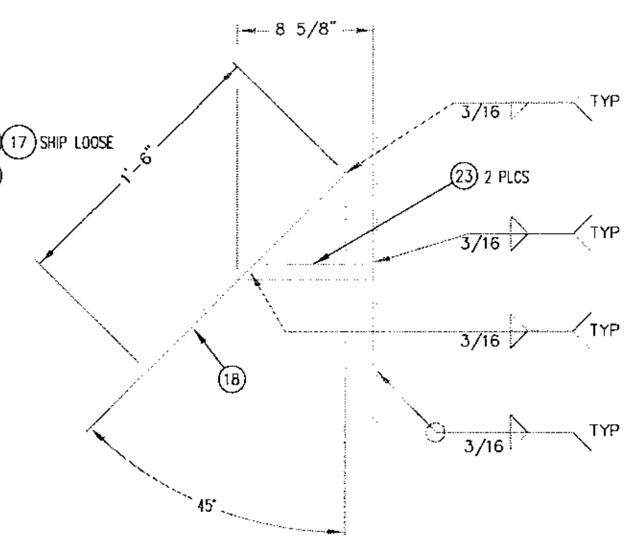


A M1 ELEVATION VIEW
NOT TRUE ORIENTATION

AS FABRICATED

FEB. 7, 2007

NOTE: DRAWING DOES NOT REFLECT FIELD REVISIONS



2 KOP INLET BAFFLE DETAIL

SCALE: 2X

BILL OF MATERIAL

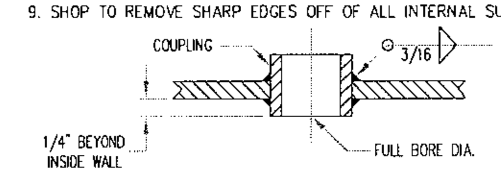
ITEM	QTY	DESCRIPTION	SUPPLIER	PART NO.	INVENTORY AMOUNT
1	1	KOP 48" ASSEMBLY	LFG	KOP48	
2	1	12" KOP INLET/OUTLET ASSY.	LFG	12KOPI/OASS	
3	1	NITROGEN BOTTLE RACK	LFG	NISTAND	
4	48	1/2" – 13 UNC BOLT CS – 2" LG	LFG	FLOOR STOCK	
5	48	1/2" – 13 UNC HEX NUT CS	LFG	FLOOR STOCK	
6	96	1/2" FLAT WASHER CS	LFG	FLOOR STOCK	
7	1	NEOPRENE GASKET 54" OD x 48" ID x 1/4" THK	LFG	WFGR48X54	
8	4	MIST PAD TABS	LFG	MISTPADTABS	
9	1	20 MICRON 304 SS DEMISTER OD TO MATCH TANK ID	LFG	MIST48X2-304	
10	4	KOP FEET	LFG	KOPFEETLG	
11	1	KOP HIGH LEVEL SWITCH ASSEMBLY	LFG	KOPSWBLIND	
12	2	GASKET NON-ASBESTOS F-F 2 1/2"	LFG	WFG212NA	
13	1	FLANGE BLIND CS 150# 2 1/2"	LFG	KOP212B	
14	2	KOP PORT	LFG	KOPPORT	
15	4	ANGLE A36 CS 3" X 3" X 1/4"	LFG	SA3X14	1.5
16	4	BAR HR A36 CS 1/4" X 3"	LFG	SB03X14	.25
17	1	10" KOP INLET/OUTLET ASSY.	LFG	10KOPI/OASS	
18	1	1/4" THK PLATE CS 1'-0 3/4" x 1'-6"	LFG	SP4X814	1.75
19	1	2" HALF COUPLING SS THREADED	LFG	FLOOR STOCK	
20	2	PLUG 1/2" CS THRD	LFG	FLOOR STOCK	
21	1	1" CLOSE NIPPLE SCH 40 SS	LFG	FLOOR STOCK	
22	2	1/2" FULL COUPLING SS THREADED	LFG	FLOOR STOCK	
23	2	1/4" THK x 1" BAR CS	LFG	SB1X14CH	.7
24	1	REDUCING BUSHING 2" X 1" SS	LFG	FLOOR STOCK	
25	1	SIGHT GAGE	LFG	PFSG	
26	1	1/2" WATER GAUGE CONBRACO (2 PET SET)	LFG	PFGS-V	
27	2	PROTECTION RODS	LFG	SR316S	

NOZZLE SCHEDULE

MARK	B/M NO.	SIZE	EXT	PROJ	RATING	MATL	DESCRIPTION
A	2	12	9	2	150 RFSO	CS	GAS INLET
B	2	12	9	2	150 RFSO	CS	GAS OUTLET
H1	14	2 1/2	–	–	150 RFSO	CS	HIGH LEVEL SWITCH
G1	22	1/2	–	–	F.CPLG	SS	GAGE
G2	22	1/2	–	–	F.CPLG	SS	GAGE
L1	14	2 1/2	–	–	150 RFSO	CS	INSPECTION PORT
N1	19	2	–	–	H.CPLG	SS	DRAIN
P1	20	1/2	–	–	H.CPLG	CS	PORT
P2	20	1/2	–	–	H.CPLG	CS	PORT

NOTES:

1. ALL BOLTS, CAP SCREWS AND NUTS WILL BE SAE GRADE 8 WITH YELLOW ZINC DICHROMATE PLATING. THREADED RODS WILL BE LOW CARBON STEEL WITH YELLOW ZINC DICHROMATE PLATING. ALL THREADS WILL BE UNIFIED NATIONAL COARSE.
2. ALL 1/8"-1 1/2" PIPES WILL BE STANDARD BLACK PIPE ASTM A53 OR ASTM A106. ALL 1/8"-1 1/2" PIPE NIPPLES WILL BE STANDARD BLACK PIPE ASTM A733. 3. ALL 1/8"-1 1/2" PIPE FITTINGS (ELBOWS, TEES, BUSHINGS & ETC.) WILL BE STANDARD (CLASS 150) WITH A BLACK FINISH.
3. VESSEL & PIPE SURFACES (INTERIOR & EXTERIOR) TO BE BLASTED TO SP-7 SPECIFICATIONS.
4. VESSELS AND PIPE EXTERNALS TO BE COATED WITH RUST PROHIBITING SHERWIN WILLIAMS B67R5 RED OXIDE RECOATABLE PRIMER AND FINISHED WITH A 3 MIL COAT OF SLATE GREY COLORED INDUSTRIAL ACRYLIC POLYURETHANE, SHERWIN WILLIAMS ACROLON 218 HS.
5. VESSEL & PIPE INTERNAL WETTED SURFACES ARE TO BE COATED WITH SHERWIN WILLAMS PHENICON HS FLAKE FILLED SOLID EPOXY.
6. ALL PIPE BUTT WELD JOINTS WILL HAVE A 1/8" ROOT OPENING.
7. ALL FLANGE BOLT HOLES TO STRADDLE HORIZONTAL AND VERTICAL CENTERLINES.
8. ALL PIPE SPOOLS TO BE STANDARD WT. C.S. UNLESS NOTED.
9. SHOP TO REMOVE SHARP EDGES OFF OF ALL INTERNAL SURFACES.



TYP. COUPLING WELD DETAIL

SCALE: NONE

Shaw® LFG Specialties, L.L.C.

REV	DESCRIPTION / ISSUE	DATE	BY
1	AS FABRICATED	2/7/07	CLK
0	RELEASED FOR PURCHASING	9/28/06	CLK

TITLE: 48" DIA x 72" LG KNOCK OUT POT ASSEMBLY

PROJECT NAME: LANDFILL GAS UTILITY FLARE #PCFT1242110 RENTAL UNIT

DRAWN BY	ENGINEER	APPROVED BY	SIZE
CLK	RS	RS	D

SCALE	DATE	PROJECT NO.
1" = 1'-0"	9/28/05	110157

CUSTOMER	SERIAL NO.	DWG NO.	SHT.	REV.
LFG SPECIALTIES	2065	KOP	1	1

Shaw® LFG Specialties, L.L.C.

16406 US ROUTE 224 E
FINDLAY, OH 45840-9761
PHONE: (800) 331-7683 or (419) 424-4999
FAX: (419) 424-4939 or (419) 424-4991

DRAWING NO.	LIST OF DRAWINGS
2065-ET	ELECTRICAL TITLE PAGE & LEGEND
2065-EP1	ELECTRICAL POWER DISTRIBUTION ONE LINE DIAGRAM
2065-EP2	POWER PANEL LAYOUT
2065-EP3	POWER PANEL BACKPLATE LAYOUT
2065-EPB	POWER PANEL AND POWER DEVICES BOM
2065-EP000	POWER PANEL SCHEMATIC (480VAC POWER SCHEMATIC)
2065-EP050	POWER PANEL SCHEMATIC (120VAC POWER SCHEMATIC)
2065-EC1	FLAME-TROL I CONTROL PANEL LAYOUT
2065-EC3	FLAME-TROL I CONTROL PANEL BACKPLATE LAYOUT
2065-EC100	FLAME-TROL I CONTROL PANEL ELECTRICAL SCHEMATIC
2065-EC200	FLAME-TROL I CONTROL PANEL ELECTRICAL SCHEMATIC
2065-EC300	FLAME-TROL I CONTROL PANEL SCHEMATIC - CHART RECORDER
2065-ECB	FLAME-TROL I CONTROL PANEL BOM
2065-EJ1	FLARE JUNCTION BOX ASSEMBLY & BOM
2065-EW1	SHOP & FIELD WIRING DIAGRAM - SIMPLIFIED
2065-EW2	SHOP & FIELD WIRING INTERCONNECTION DIAGRAM

LANDFILL GAS UTILITY FLARE #PCFT1242I10
RENTAL UNIT

LEGEND

ELECTRICAL SCHEMATICS

SIGNALS CONNECTED
SIGNALS NOT CONNECTED

CONTROLS SCHEMATIC REFERENCES

1	INTERNAL DEVICE OR EQUIPMENT CONNECTIONS
[XXX-XXX]	P&ID REFERENCES
[XXXX]	EXTERNAL PANEL ALTERNATE WIRE NUMBER

CONTROLS SCHEMATIC SYMBOL LEGEND

TERMINAL POINT (BACK PLATE)
TERMINAL POINT (SWING DOOR)
SKID MOUNTED DEVICES
SKID WIRING
14 GA. WIRE

WIRE COLOR CODE

SIGNAL	COLOR	SIGNAL	COLOR
DC	BLUE	GROUND	GREEN
120VAC	RED	EXTERNALLY POWERED	YELLOW
NEUTRAL (120VAC)	WHITE	INTRINSICALLY SAFE	LT BLUE
POWER WIRING	BLACK		

ONE LINE POWER DIAGRAM SYMBOLS

800A M — BREAKER CURRECT REATING TYPE OF CIRCUIT BREAKER
5A — FUSE RATING
60A — NON FUSED DISCONNECT SWITCH
MOTOR CONTACTOR
MOTOR OVERLOAD
25HP 40A — FUSIBLE DISCONNECT, HP RATING, FUSE RATING
VFD OR SOFT STARTER
TRANSFORMER
25 / 34A — MOTOR HORSEPOWER, MOTOR FULL LOAD AMPS
GROUND

TIMED CONTACTS

CONTACT ACTION DELAYED AFTER COIL IS:
ENERGIZED:
TDO TR01 NORMALLY OPEN
TDC TR01 NORMALLY CLOSED
DENERGIZED:
TDO TR01 NORMALLY OPEN
TDC TR01 NORMALLY CLOSED
TDC-TIME DELAY CLOSING
TDO-TIME DELAY OPENING

FLOW SWITCHES

FS-XXX NORMALLY OPEN (CLOSES ON INCREASING FLOW)
FS-XXX NORMALLY CLOSED (OPENS ON INCREASING FLOW)

LIQUID LEVEL SWITCHES

LS-XXX NORMALLY OPEN
LS-XXX NORMALLY CLOSED

VACUUM & PRESSURE SWITCHES

PS-XXX NORMALLY OPEN (CLOSES ON RISING PRESSURE)
PS-XXX NORMALLY CLOSED (OPENS ON RISING PRESSURE)

TEMPERATURE SWITCHES

TS-XXX NORMALLY OPEN (CLOSES ON RISING TEMPERATURE)
TS-XXX NORMALLY CLOSED (OPENS ON RISING TEMPERATURE)

LIMIT SWITCHES

DIRECTLY ACTUATED, SPRING RETURNED
ZS-XXX NORMALLY OPEN
ZS-XXX HELD CLOSED
ZS-XXX NORMALLY CLOSED
ZS-XXX HELD OPEN

RELAY CONTACTS

XX-XXX NORMALLY OPEN (CLOSED WHEN ENERGIZED OR OPERATED.)
XX-XXX NORMALLY CLOSED (OPEN WHEN ENERGIZED OR OPERATED.)

MISC.

SPI47 — RC SUPPRESOR CIRCUIT (AC)
SUPPA11 — DIODE SUPPRESOR CIRCUIT (DC)
RESISTOR
THERMOCOUPLE
3 WIRE RTD

Shaw® LFG Specialties, L.L.C.

REV	DESCRIPTION / ISSUE	DATE	BY
0	AS FABRICATED	02/06/07	REM

ELECTRICAL TITLE PAGE & LEGEND

DRAWN BY	ENGINEER	APPROVED BY	SIZE
R. MCQUILLEN	J. SCHROEDER	R. SEGOVIA	D
SCALE	DATE	PROJECT NO	
NONE	05/12/05	110157	

PROJECT NAME: LANDFILL GAS UTILITY FLARE #PCFT1242I10 RENTAL UNIT

CUSTOMER	SERIAL NO	DWG NO	SHT
RENTAL UNIT	2065	ET	1

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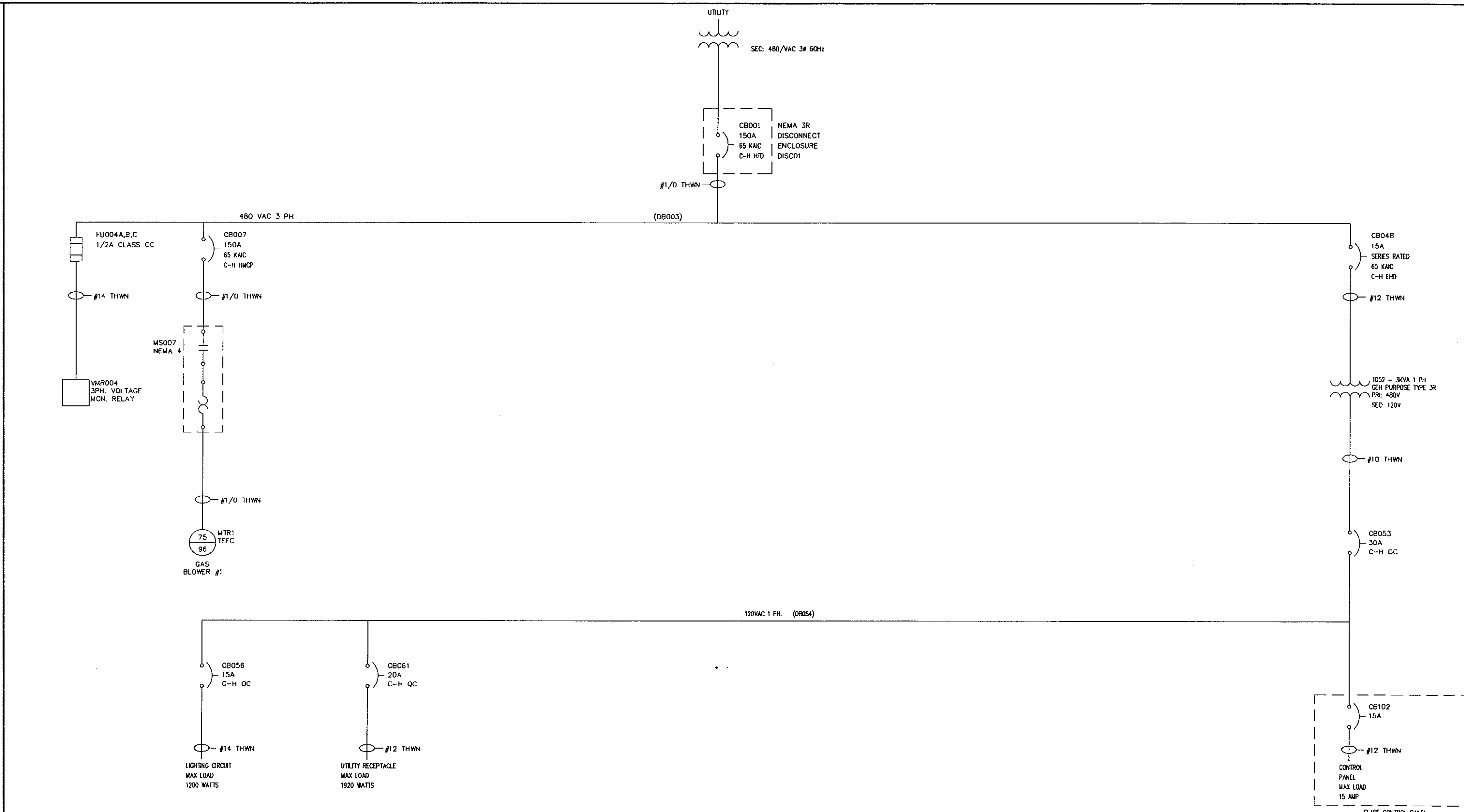

Shaw® LFG Specialties, L.L.C.

REV	DESCRIPTION / ISSUE	DATE	BY
0	AS FABRICATED	02/06/07	REM

WIRE COLOR CODE

SIGNAL	COLOR	SIGNAL	COLOR
DC	BLUE	GROUND	GREEN
120VAC	RED	EXTERNALLY POWERED	YELLOW
NEUTRAL (120VAC)	WHITE	INTRINSICALLY SAFE	LT BLUE
POWER WIRING	BLACK		

ELECTRICAL POWER DISTRIBUTION
ONE LINE DIAGRAM

DRAWN BY:	ENGINEER:	APPROVED BY:	SIZE:
R. MCQUILLEN	J. SCHROEDER	R. SEGOVIA	D

SCALE:	DATE:	PROJECT NO:
NONE	10/05/06	110157

PROJECT NAME: LANDFILL GAS UTILITY FLARE #PCFT124210
RENTAL UNIT

CUSTOMER	SERIAL NO:	DWG NO:	SHT:
RENTAL UNIT	2065	EP1	1

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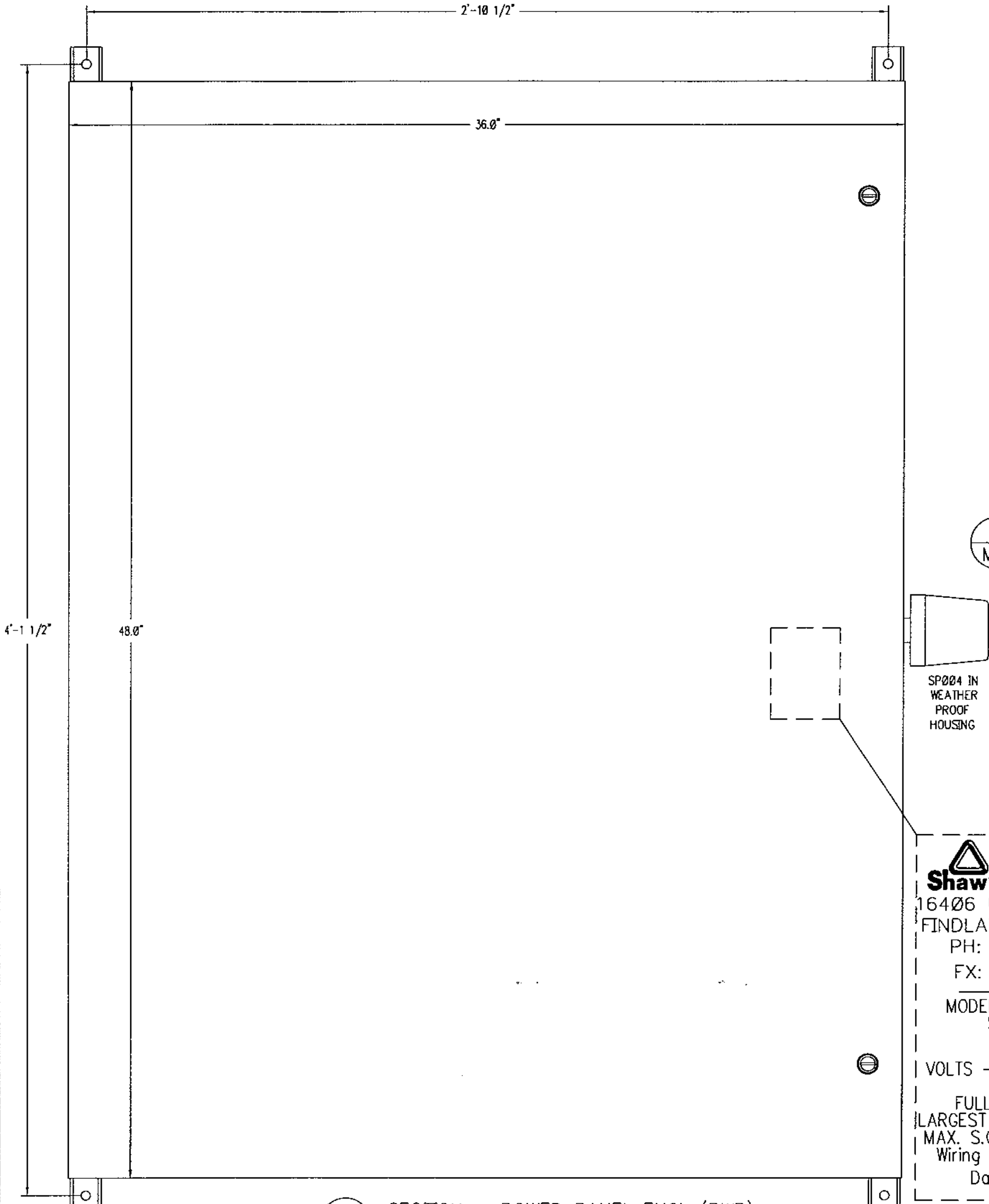


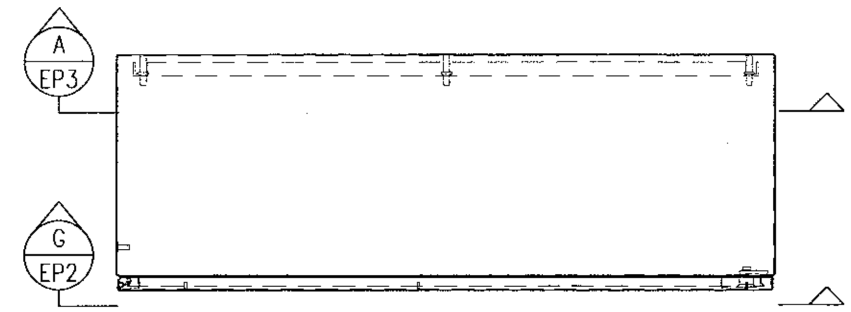
Shaw™ LFG SPECIALTIES
16406 U.S. RTE. 224 EAST
FINDLAY OH 45840-9761
PH: (419) 424-4999
FX: (419) 424-4991

MODEL NO. FLAME-TROL I
SERIAL NO. 2065
PANEL: POWER

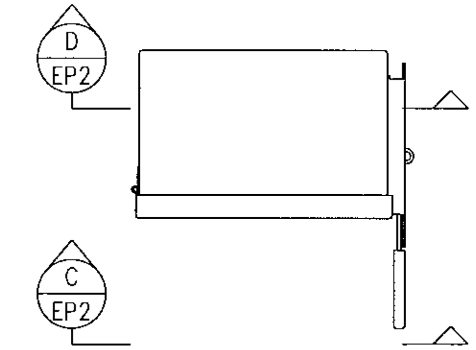
VOLTS - 480VAC PHASE - 3PH
FREQ - 60HZ
FULL LOAD AMPS - 80A
LARGEST MOTOR - 40 HP,52 FLA
MAX. S.C.C. - 65kAIC RMS Sym.
Wiring Diagram: 2065-EP000
Date Code: 10/2006

NOTE: UL INFORMATION TAG

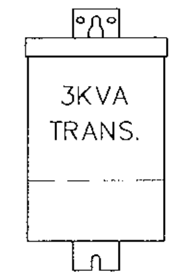
G/EP2 SECTION - POWER PANEL ENCL (PWR)
SCALE: 3:1



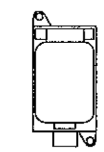
(PWR)
D/MR1 POWER PANEL - PLAN VIEW
SCALE: NTS



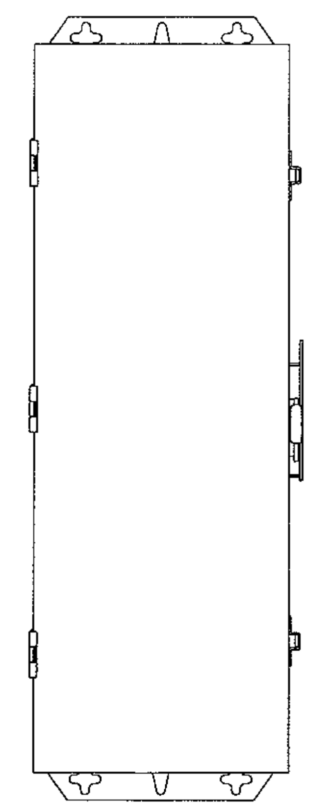
(DISC01)
DISCONNECT - PLAN VIEW
SCALE: 3:1



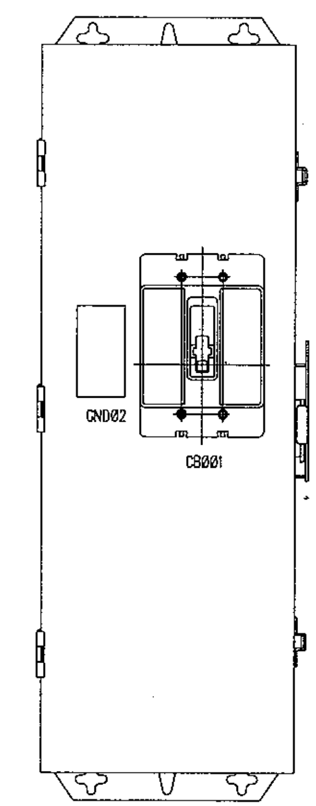
(T052)
B/MR1 TRANSFORMER - ELEVATION
SCALE: NTS



D/MR1 GFCI RECEPTACLE -(GFCI061)
SCALE: NTS



C/MR1 SECTION - DISCONNECT (DISC01)
SCALE: 3:1



D/EP2 SECTION - INTERNALS
SCALE: 3:1

Shaw® LFG Specialties, L.L.C.

REV	DESCRIPTION / ISSUE	DATE	BY
0	AS FABRICATED	02/06/07	REM

WIRE COLOR CODE

SIGNAL	COLOR	SIGNAL	COLOR
DC	BLUE	GROUND	GREEN
120VAC	RED	EXTERNALLY POWERED	YELLOW
NEUTRAL (120VAC)	WHITE	INTRINSICALLY SAFE	LT BLUE
POWER WIRING	BLACK		

POWER PANEL LAYOUT

DRAWN BY:	CHECKED:	APPROVED BY:	SIZE:
R. MCQUILLEN	J. SCHROEDER	R. SEGOVIA	D

SCALE	DATE:	PROJECT NO:
AS SHOWN	10/05/06	110157

PROJECT NAME: LANDFILL GAS UTILITY FLARE #PCFT1242I10 RENTAL UNIT

CUSTOMER	SERIAL NO:	DWG NO:	SHT:
RENTAL UNIT	2065	EP2	1

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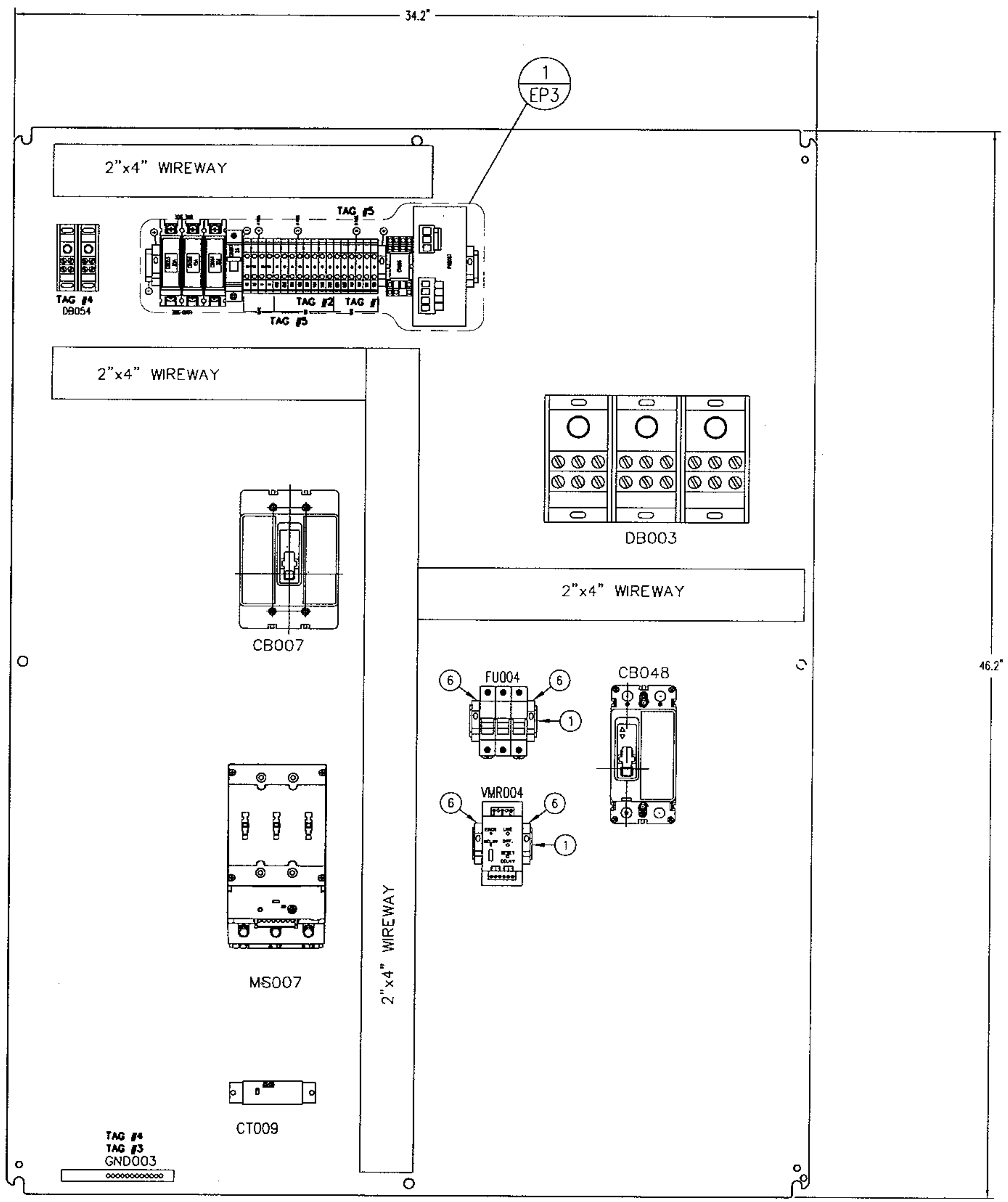
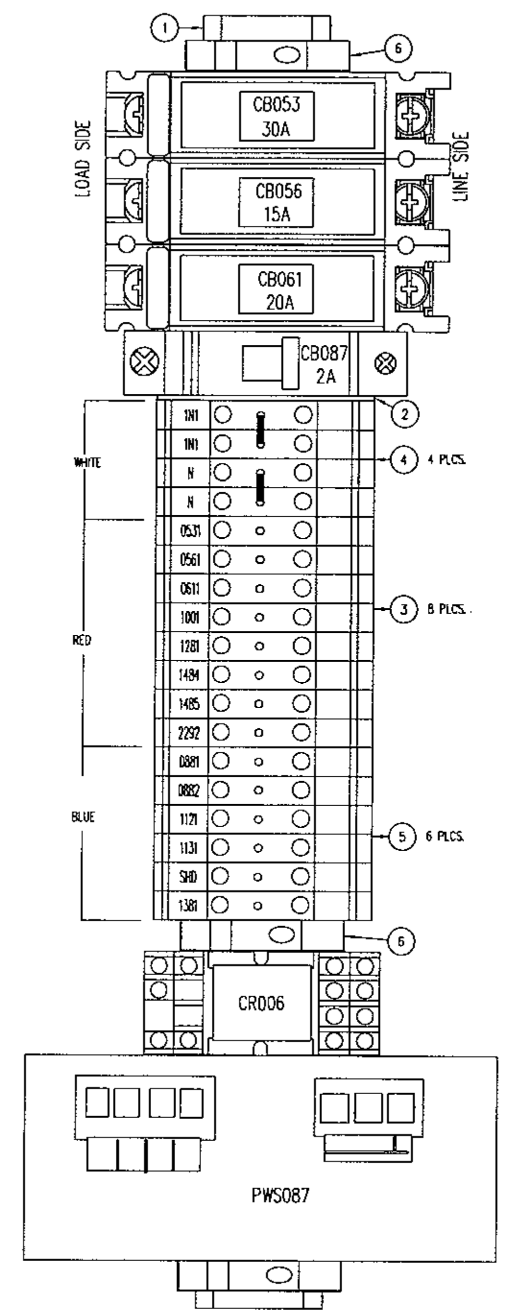


A
EP2
SECTION – BACK PLATE OF POWER PANEL
SCALE: 3:1



1
EP3
DETAIL – DIN RAIL DETAIL
SCALE: FULL

LABEL & PLAQUE DETAIL

CIRCUIT BREAKER LEGEND		
BREAKER ID	TYPE	DESCRIPTION
CB007	MCP	BLOWER #1
CB048	MCB	CONTROL XFMR PRIMARY (T052)
CB053	MCB	CONTROL XMER SECONDARY (T052)
CB056	MCB	SPARE
CB061	MCB	GP RECEPTACLE
CB087	SUPPLEMENTAL	MOTOR STARTER CONTROL POWER

LOCATE LABEL ON LEFT SIDE WALL OF ENCLOSURE CLOSE TO BREAKERS

TAG #1
Use 105° C rated copper wire.

TAG #2
WEIDMULLER WDU6
TORQUE to 7.1 lb-in

TAG #3

TAG #4
GE TGK12
TORQUE to 30 lb-in

TAG #5
C-H QC BREAKERS
TORQUE to 30 lb-in

Shaw® LFG Specialties, L.L.C.

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WIRE COLOR CODE			
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DC	BLUE	GROUND	GREEN
120VAC	RED	EXTERNALLY POWERED	YELLOW
NEUTRAL (120VAC)	WHITE	INTRINSICALLY SAFE	LT BLUE
POWER WIRING	BLACK		

POWER PANEL
BACKPLATE LAYOUT

DRAWN BY:	ENGINEER:	APPROVED BY:	SIZE:
R. MCQUILLEN	J. SCHROEDER	R. SEGOVIA	D
SCALE: AS SHOWN	DATE: 10/05/06	PROJECT NO. 110157	

PROJECT NAME: LANDFILL GAS UTILITY FLARE #PCFT124210
RENTAL UNIT

CUSTOMER: RENTAL UNIT | SERIAL NO: 2065 | DWG NO: EP3 | SHT: 1

File: F:\LFG\2000 DRAWINGS\2065\ELECTRICAL\2065-EP3.dwg Layout: EP3 User: randy.mcquillen Feb 08, 2007 - 9:09am

BILL OF MATERIAL

DEVICE	ID	QTY	DESCRIPTION	MANUFACTURER	SUPPLIER	PART NO.
CB	001	1	DISCONNECT BREAKER (150A)	CUTLER HAMMER	HFD3150L	ECB150A3PHFD
DISC	01	1	DISCONNECT ENCLOSURE	CUTLER HAMMER	RFDN225	CHRFDN225
GND	02	1	NEUTRAL KIT	CUTLER HAMMER	INK100	CH100ANK
DB	003	3	DISTRIBUTION BLOCK (1)-500MCM-#4 LINE x (6)- #2/0-#14 LOAD	NSI	AL-R1-K6	EDBALR1K6
DB	003	3	DISTRIBUTION BLOCK COVER (FOR AL SERIES BLOCKS)	NSI	CL	EDBCVR-L
GND	003	1	GROUNDING BAR 12 POINTS	GE	TGK12	FLOOR STOCK
FU	004	1	3 POLE FUSE HOLDER CLASS CC	FERRAZ SHAWMUT	USCC3	E3PVMRFH
FU	004A-C	3	1/2A CLASS CC FUSES 600VAC RATED	FERRAZ SHAWMUT	ATDR1/2	E3PVMRF12
SP	004	1	3 PHASE SERVICE ENTRANCE SURGE PROTECTOR 600 VAC RATED	CUTLER HAMMER	CHSA03	ESA3Q600V
VMR	004	1	VOLTAGE MONITOR RELAY	RK ELECTRONICS	PVTR-201-A2C	E3PVMR
CR	006	1	MINIATURE RELAY 4PDT 120VAC 5A WITH INDICATING LIGHTS	OMRON	MY4IN AC110/120	ER4PDT5A-L-M
	-	1	RELAY SOCKET	OMRON	PYF14A-N	ERBASE
CB	007	1	MOTOR CIRCUIT PROTECTOR (150A)	CUTLER HAMMER	HMCP150T4C	EMCP150A3P
MS	007	1	MOTOR STARTER IT SERIES SZ 4 FVNR 24V COIL	CUTLER HAMMER	N101ES4P3A	EMS4-IT
CT	009	1	CURRENT TRANSFORMER	INST. TRANS	2SFT101	ECT100/5
CB	048	1	CIRCUIT BREAKER (15A 2 POLE)	CUTLER HAMMER	EHD2015L	CHEHD2015L
T	052	1	TRANSFORMER 3KVA	CUTLER HAMMER	S20N11S03N	ETR3KVA
CB	053	1	CIRCUIT BREAKER (30A 1 POLE)	CUTLER HAMMER	QC-1030	CHQC1030
DB	054	2	DISTRIBUTION BLOCK (1)-#2/0-#14 LINE x (4)- #4-#14 LOAD	NSI	AS-K1-H4	EDBASK1H4
DB	054	2	DISTRIBUTION BLOCK COVER (FOR AS SERIES BLOCKS)	NSI	CS	EDBCVR-S
CB	056	1	CIRCUIT BREAKER (15A 1 POLE)	CUTLER HAMMER	QC-1015	CHQC1015
CB	061	1	CIRCUIT BREAKER (20A 1 POLE)	CUTLER HAMMER	QC-1020	CHQC1020
GFCI	061	1	20A PERSONNEL RATED 125V GFCI RECEPTACLE	HUBBELL	GF5352IC	EGFCI
GFCI	061	1	NEMA 4 SINGLE GANG RECEPTACLE BOX	HUBBELL	5320-0	EGFCI-BOX
GFCI	061	1	WEATHER PROOF COVER FOR GFCI RECEPTACLE	RACO	5002-0	FLOOR STOCK
CB	087	1	CIRCUIT BREAKER (2A)	GE	EP101ULC02	ECB2A1PD
PWS	087	1	IT POWER SUPPLY (55W)	CUTLER HAMMER	PSS55A	EPS120V55W
-	-	1	DIN RAIL ADAPTER (FOR IT POWER SUPPLY)	CUTLER HAMMER	PSSPIN	EPSSDIN
PWR		1	POWER PANEL BACK PLATE	HOFFMAN	C-P4836	EBX4836P
PWR		1	ENCLOSURE MTG FEET	HOFFMAN	C-MFKSS	EBXMTGFTR
PWR		1	MOTOR CONTROL CENTER ENCLOSURE	HOFFMAN	C-SD483616	EBX48X36X16N4
-	-	3	DIN RAIL ADAPTER (FOR CB053-061)	CUTLER HAMMER	DINADAPT	QCDINADAPT
		84"	2"x 4" WIRING DUCT	PANDUIT	G2X4LG6	EWW2X4-LG
		84"	2" WIREWAY COVER	PANDUIT	C2LG6	EWWC2-LG
	1	16"	DIN RAIL TS 35x7.5 (5mm SLOT)	WEIDMULLER	0514500000	FLOOR STOCK
	2	1	TERMINAL BLOCK END PLATE WAP 2.5-10	WEIDMULLER	1050000000	FLOOR STOCK
	3	8	TERMINAL BLOCK 20-10AWG 600 VAC WDU 4 RED	WEIDMULLER	1020140000	EWDU4RT
	4	4	TERMINAL BLOCK 20-10AWG 600 VAC WDU 4 WHITE	WEIDMULLER	1036700000	EWDU4WS
	5	6	TERMINAL BLOCK 20-10AWG 600 VAC WDU 4 BLUE	WEIDMULLER	1020080000	EWDU4BL
	6	7	TERMINAL BLOCK END BLOCK WEW 35/2	WEIDMULLER	1037810000	FLOOR STOCK
		4	BLANK TERMINAL LABELS FOR 6mm WS12/6 10 TAGS EACH	WEIDMULLER	1609900000	FLOOR STOCK
-	-	1	SINGLE DEVICE BOX WEATHERPROOF	RACO	5340-0	ELTPHOTOCELL-BOX
-	-	1	SINGLE DEVICE BOX COVER WEATHERPROOF	RACO	5175-0	FLOOR STOCK
-	-	1	TWO DEVICE BOX WEATHERPROOF	RACO	5320-0	EGFCI-BOX
-	-	1	TWO DEVICE BOX COVER WEATHERPROOF	RACO	5174-0	FLOOR STOCK

Shaw® LFG Specialties, L.L.C.

REV	DESCRIPTION / ISSUE	DATE	BY
0	AS FABRICATED	02/06/07	REM

WIRE COLOR CODE

SIGNAL	COLOR	SIGNAL	COLOR
DC	BLUE	GROUND	GREEN
120VAC	RED	EXTERNALLY POWERED	YELLOW
NEUTRAL (120VAC)	WHITE	INTRINSICALLY SAFE	LT BLUE
POWER WIRING	BLACK		

POWER PANEL & POWER DEVICES
BOM

DRAWN BY:	ENGINEER:	APPROVED BY:	SIZE:
R. MCQUILLEN	J. SCHROEDER	R. SEGOVIA	D
SCALE: AS SHOWN	DATE: 10/05/06	PROJECT NO: 110157	

PROJECT NAME: LANDFILL GAS UTILITY FLARE #PCFT1242I10
RENTAL UNIT

CUSTOMER	SERIAL NO:	DWG NO:	SHT:
RENTAL UNIT	2065	EPB	1

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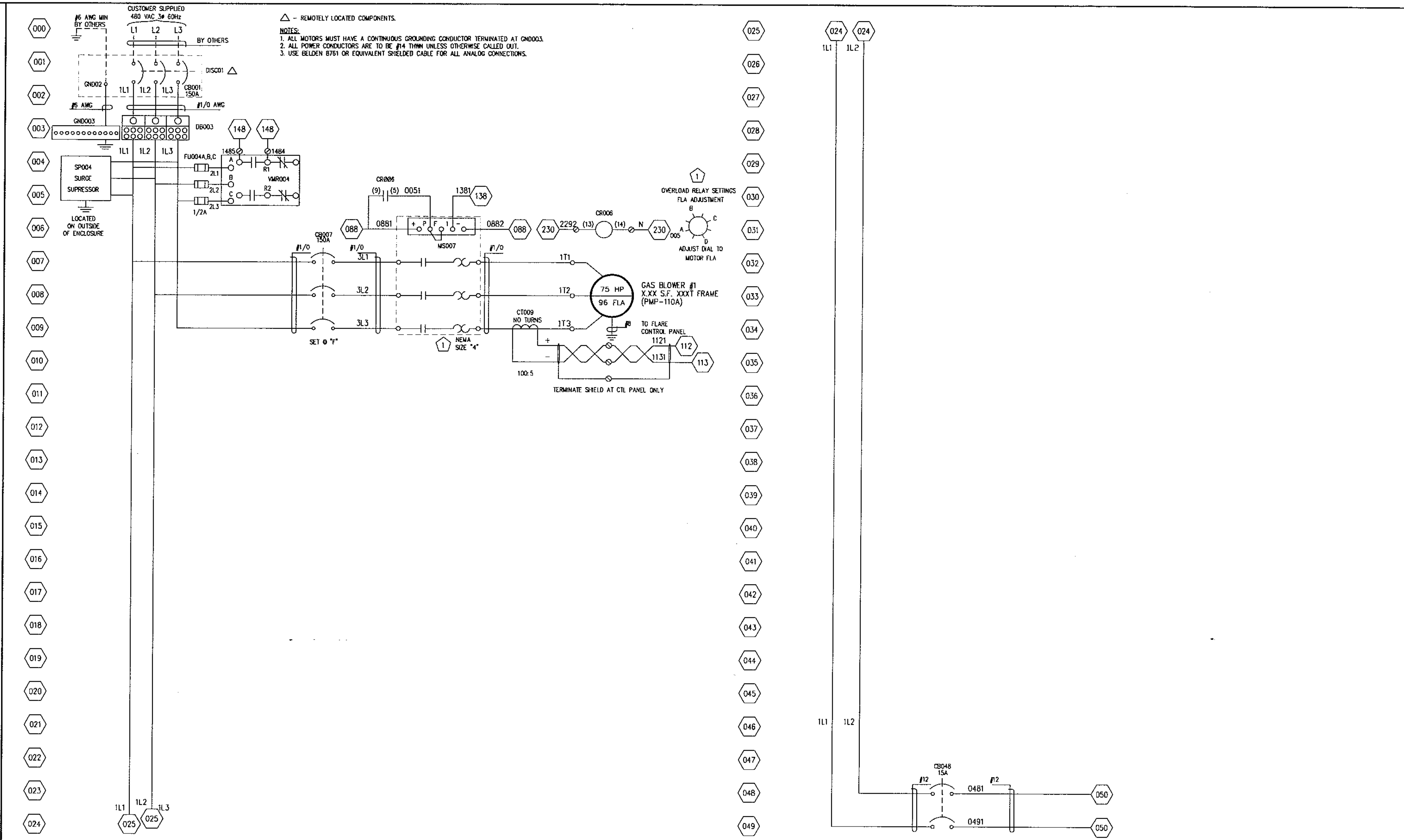

0	AS FABRICATED	02/06/07	REM
REV	DESCRIPTION / ISSUE	DATE	BY

Shaw® LFG Specialties, L.L.C.

WIRE COLOR CODE

SIGNAL	COLOR	SIGNAL	COLOR
DC	BLUE	GROUND	GREEN
120VAC	RED	EXTERNALLY POWERED	YELLOW
NEUTRAL (120VAC)	WHITE	INTRINSICALLY SAFE	LT BLUE
POWER WIRING	BLACK		

POWER PANEL SCHEMATIC
(480VAC POWER SCHEMATIC)

DRAWN BY:	ENGINEER:	APPROVED BY:	SIZE:
R. MCQUILLEN	J. SCHROEDER	R. SEGOVIA	0

SCALE	DATE:	PROJECT NO:
NONE	10/05/06	110157

PROJECT NAME: LANDFILL GAS UTILITY FLARE #PCFT1242I10
RENTAL UNIT

CUSTOMER	SERIAL NO:	DWG NO:	SHT:
RENTAL UNIT	2065	EP000	1

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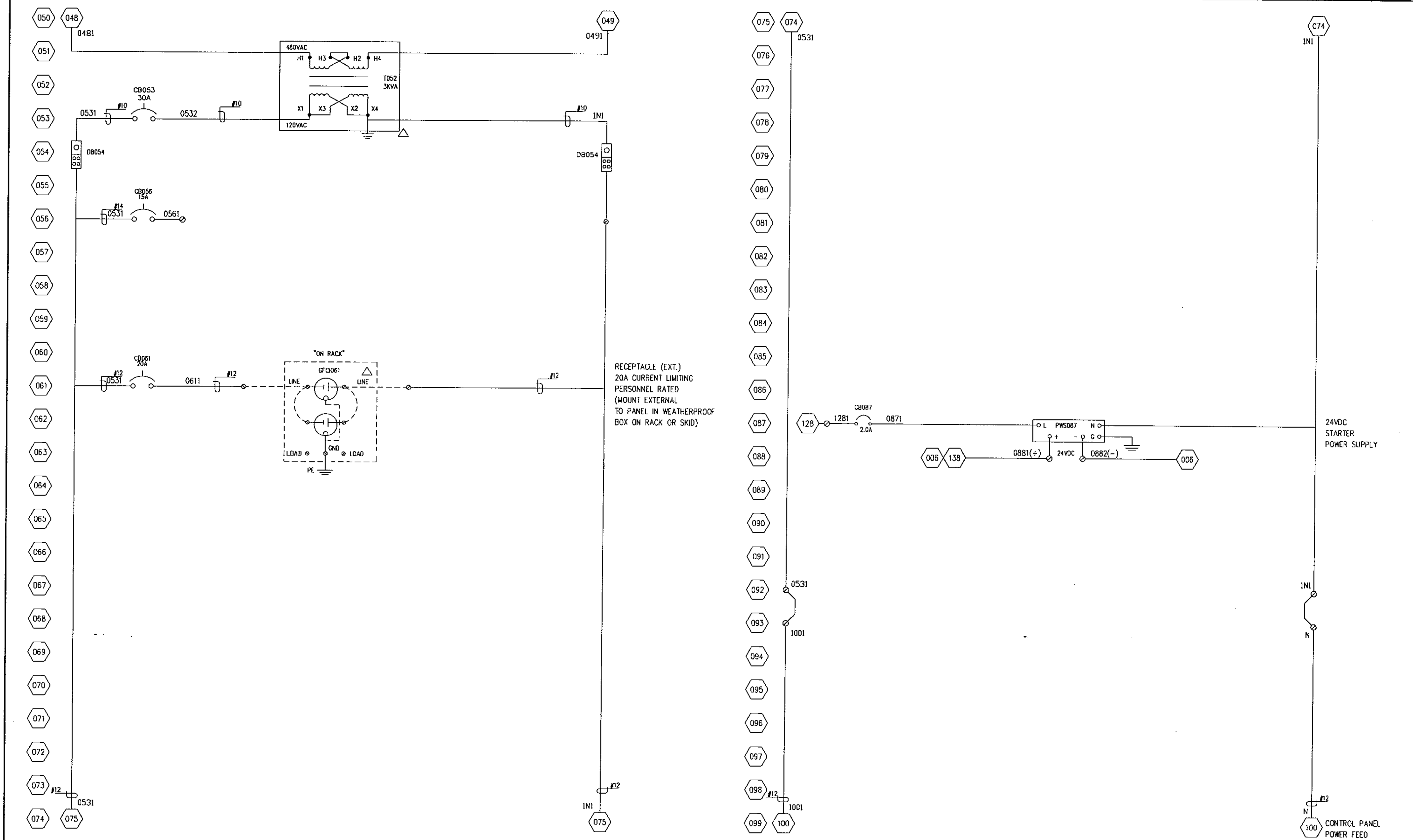

Shaw® LFG Specialties, L.L.C.

REV	DESCRIPTION / ISSUE	DATE	BY
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WIRE COLOR CODE

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120VAC	RED	EXTERNALLY POWERED	YELLOW
NEUTRAL (120VAC)	WHITE	INTRINSICALLY SAFE	LT.BLUE
POWER WIRING	BLACK		

POWER PANEL SCHEMATIC
(120VAC POWER SCHEMATIC)

DRAWN BY:	ENGINEER:	APPROVED BY:	SIZE:
R. MCQUILLEN	J. SCHROEDER	R. SEGOVIA	D

SCALE	DATE:	PROJECT NO:
NONE	10/05/06	110157

PROJECT NAME: LANDFILL GAS UTILITY FLARE #PCFT124210
RENTAL UNIT

CUSTOMER	SERIAL NO:	DWG NO:	SHT:
RENTAL UNIT	2065	EP050	1

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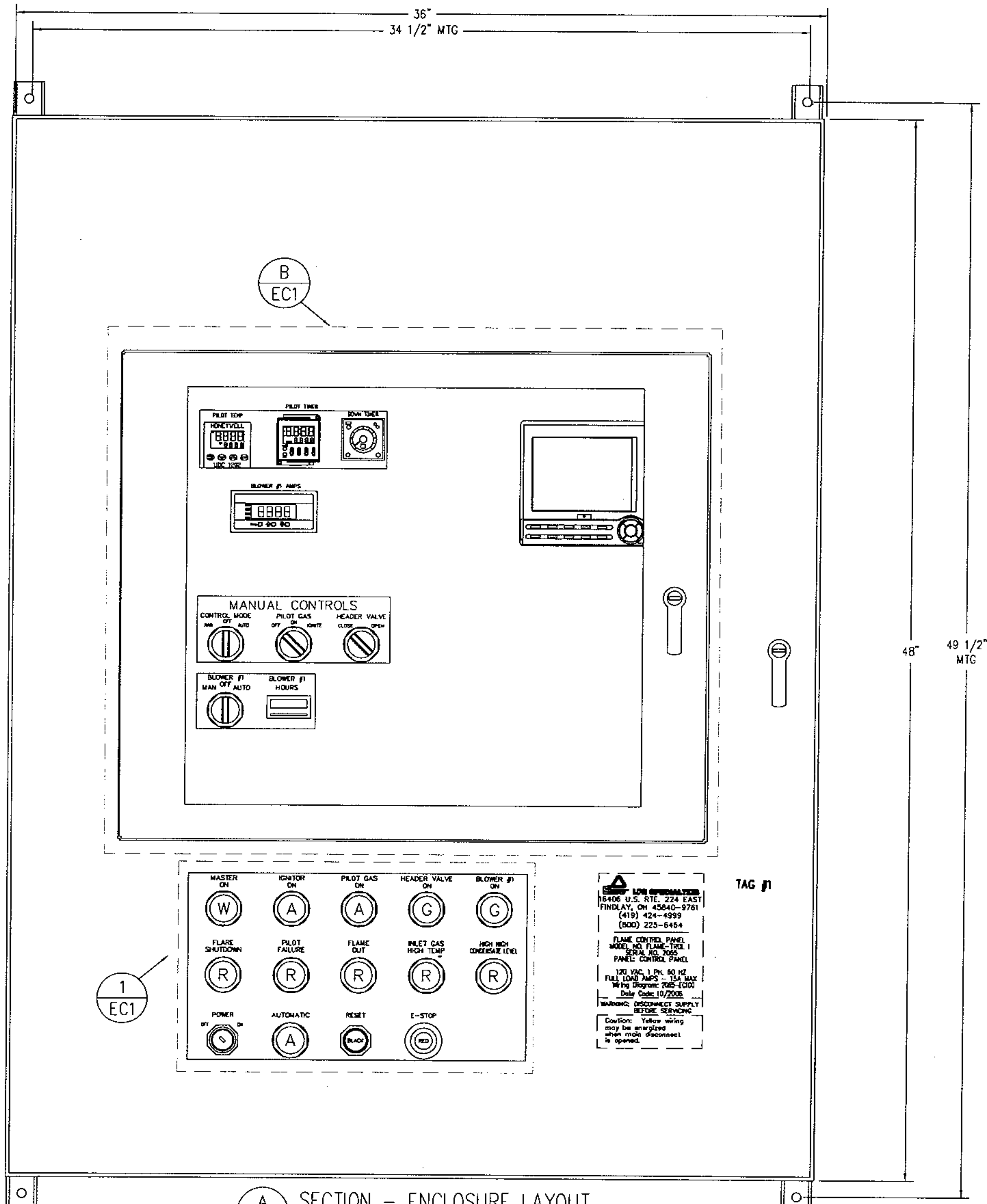
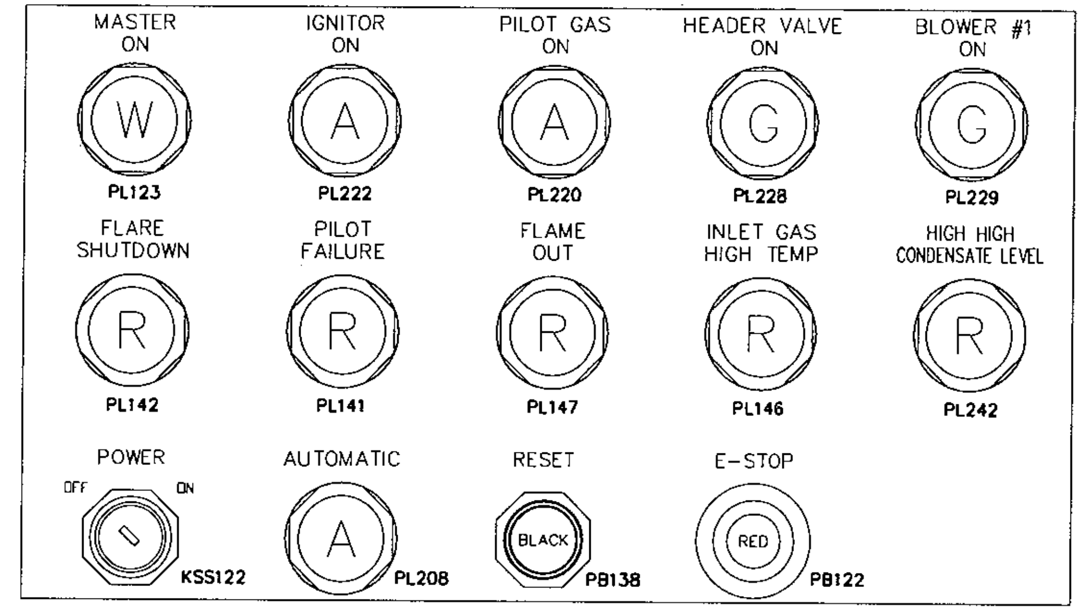
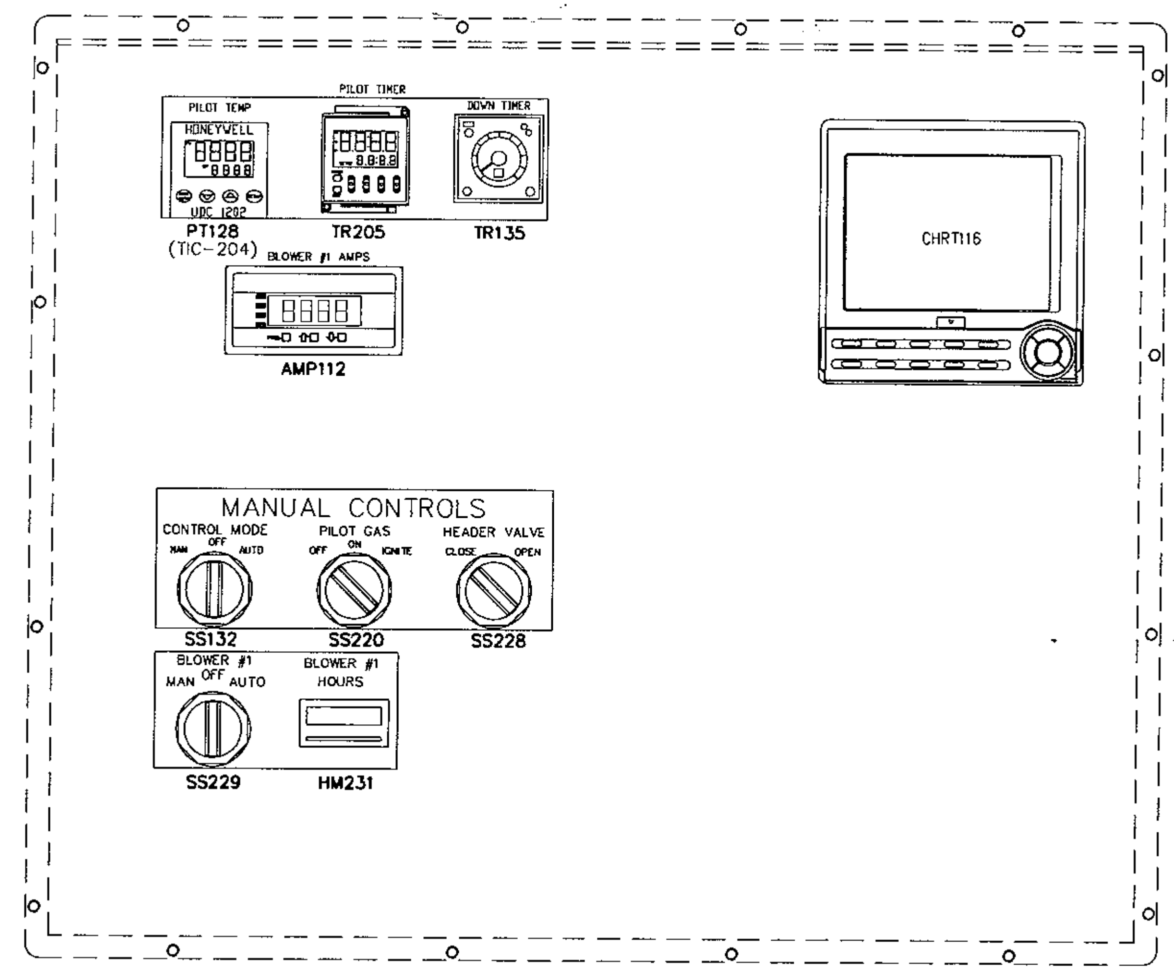


A EC1 SECTION - ENCLOSURE LAYOUT
SCALE: 3:1



1 EC1 DETAIL - BUTTON DETAIL
SCALE: FULL

LABEL DETAIL
SCALE: FULL



B EC1 SECTION - WINDOW MOUNTED DEVICES
SCALE: 2:1

Shaw® LFG Specialties, L.L.C.

REV	DESCRIPTION / ISSUE	DATE	BY
0	AS FABRICATED	02/06/07	REM

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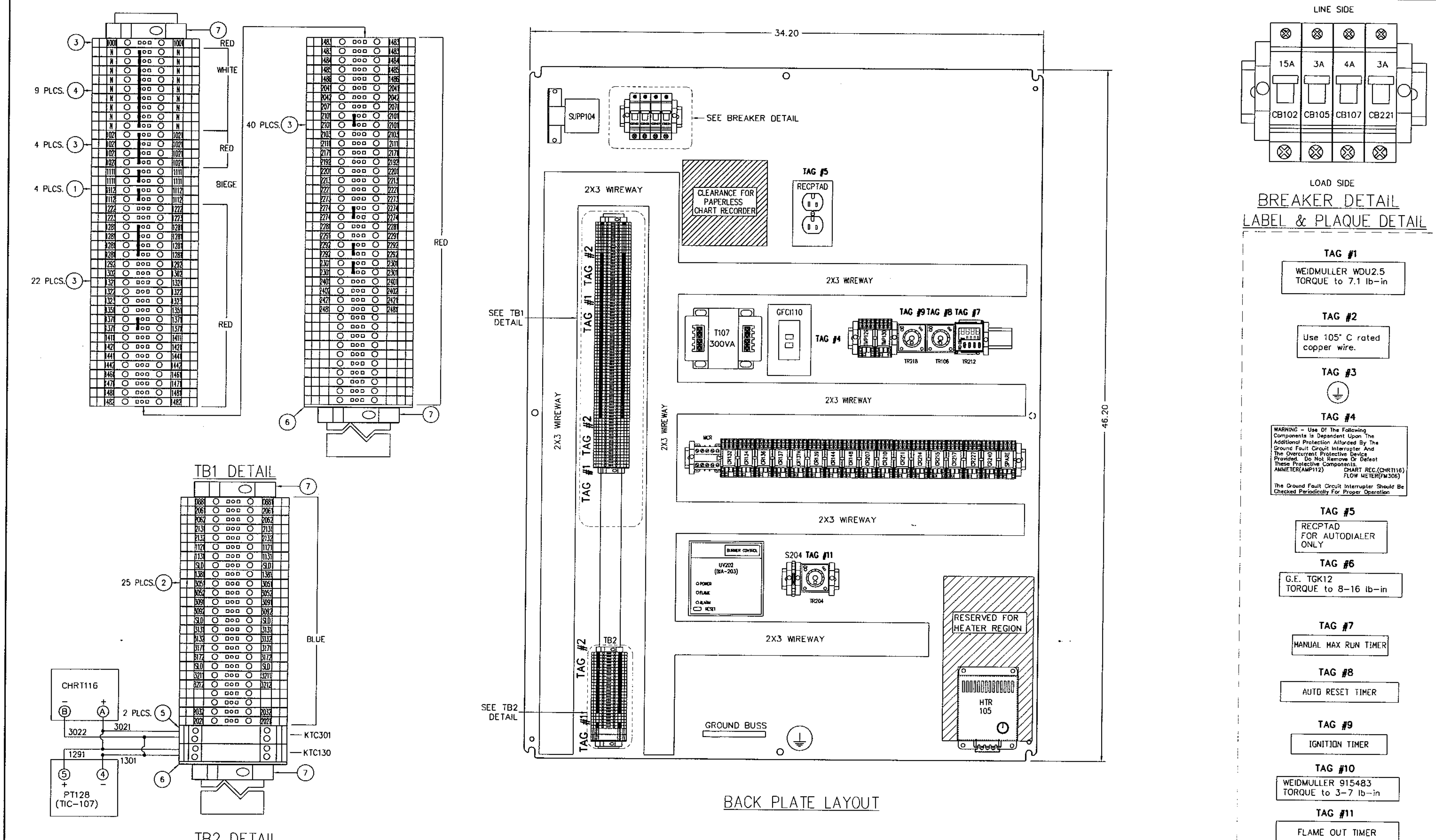
FLAME-TROL I
CONTROL PANEL LAYOUT

DRAWN BY:	ENGINEER:	APPROVED BY:	SIZE:
R. MCQUILLEN	J. SCHROEDER	R. SEGOVIA	D
SCALE: AS SHOWN	DATE: 10/05/06	PROJECT NO: 110157	

PROJECT NAME: LANDFILL GAS UTILITY FLARE #PCFT1242110 RENTAL UNIT

CUSTOMER	SERIAL NO:	DWG NO:	SHT:
RENTAL UNIT	2065	EC1	1

File: F:\LFG\2000 DRAWINGS\2065\ELECTRICAL\2065-EC1 EC2.dwg Layout: EC1 User: randy.mcquillen Feb 08, 2007 - 9:05am



Shaw® LFG Specialties, L.L.C.

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0	AS FABRICATED	02/06/07	REM

FLAME-TROL I
CONTROL PANEL BACKPLATE LAYOUT

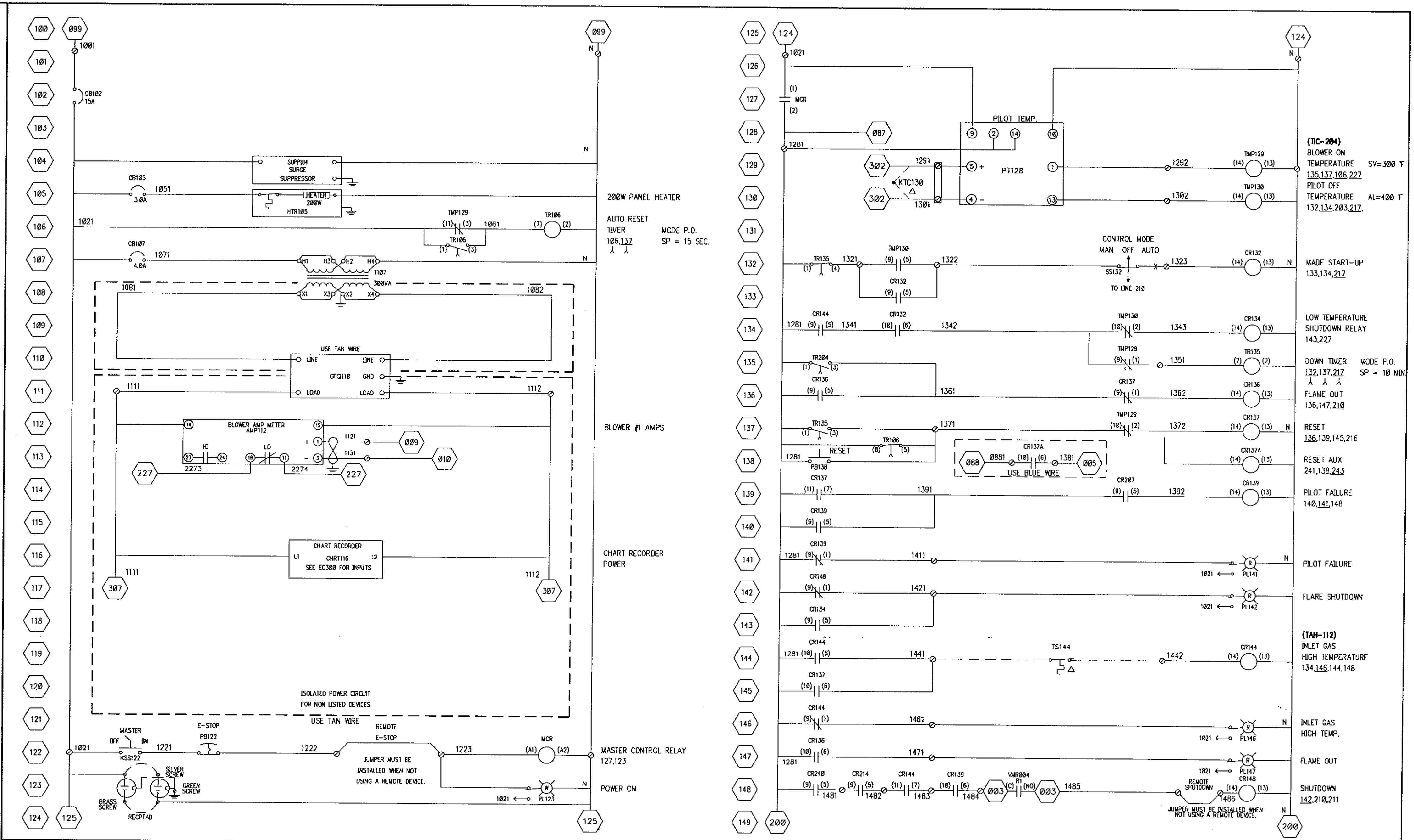
DRAWN BY	CHECKED	APPROVED BY	SIZE
R. MCQUILLEN	J. SCHROEDER	R. SEGOVIA	D

SCALE	DATE	PROJECT NO
AS SHOWN	10/05/06	110157

PROJECT NAME: LANDFILL GAS UTILITY FLARE #PCFT1242110 RENTAL UNIT

CUSTOMER	SERIAL NO	DWG NO	SHT
RENTAL UNIT	2065	EC3	1

File: F:\LFG\2000 DRAWINGS\2065\ELECTRICAL\2065-EC3.dwg Layout: B SIZE User: randy.mcquillen Feb 08, 2007 - 9:06am



Shaw® LFG Specialties, L.L.C.

REV	DESCRIPTION / ISSUE	DATE	BY
0	AS FABRICATED	02/06/07	REM

SYMBOL LEGEND

- ⊘ TERMINAL POINT (BACK PLATE)
- ⊠ TERMINAL POINT (SWING DOOR)
- △ SKID MOUNTED DEVICES
- – – – SKID WIRING
- —— 14 GA. WIRE

FLAME-TROL I
CONTROL PANEL ELECTRICAL SCHEMATIC

DRAWN BY	CHECKED	APPROVED BY	SIZE
R. MCQUILLEN	J. SCHROEDER	R. SEGOVIA	D
SCALE: NONE	DATE: 10/05/06	PROJECT NO: 110157	

PROJECT NAME: LANDFILL GAS UTILITY FLARE #PCFT1242110 RENTAL UNIT

CUSTOMER: RENTAL UNIT

SERIAL NO.	DWG NO.	SHT
2065	EC100	1

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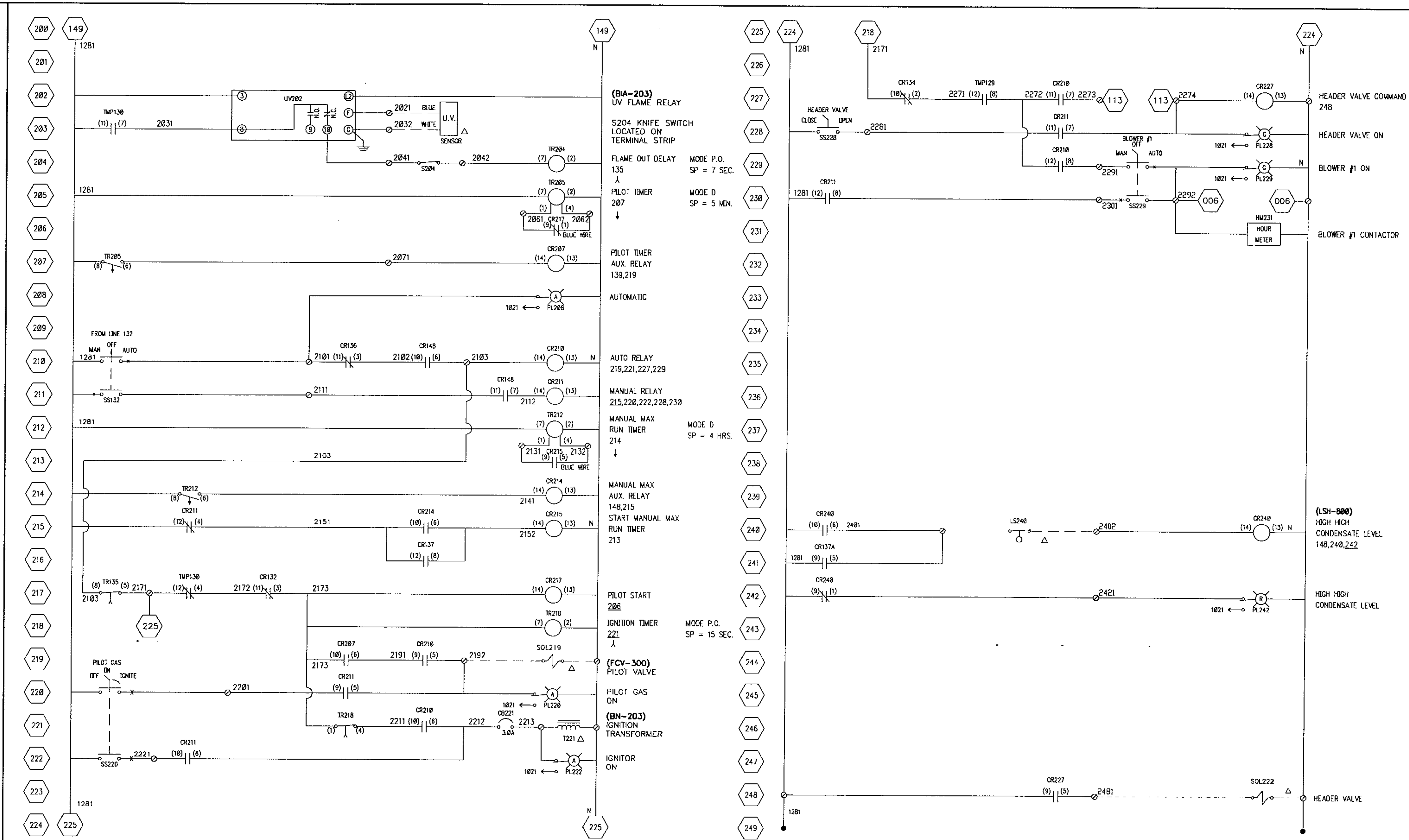

0	AS FABRICATED	02/06/07	REW	
REV	DESCRIPTION / ISSUE	DATE	BY	

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FLAME-TROL I
CONTROL PANEL ELECTRICAL SCHEMATIC

DRAWN BY:	CHECKED:	APPROVED BY:	SIZE:
R. MCQUILLEN	J. SCHROEDER	R. SEGOVIA	D
SCALE: NONE	DATE: 10/05/06	PROJECT NO: 110157	

PROJECT NAME: LANDFILL GAS UTILITY FLARE #PCFT124210 RENTAL UNIT

CUSTOMER	SERIAL NO.	DWG NO.	SHT.
RENTAL UNIT	2065	EC200	1

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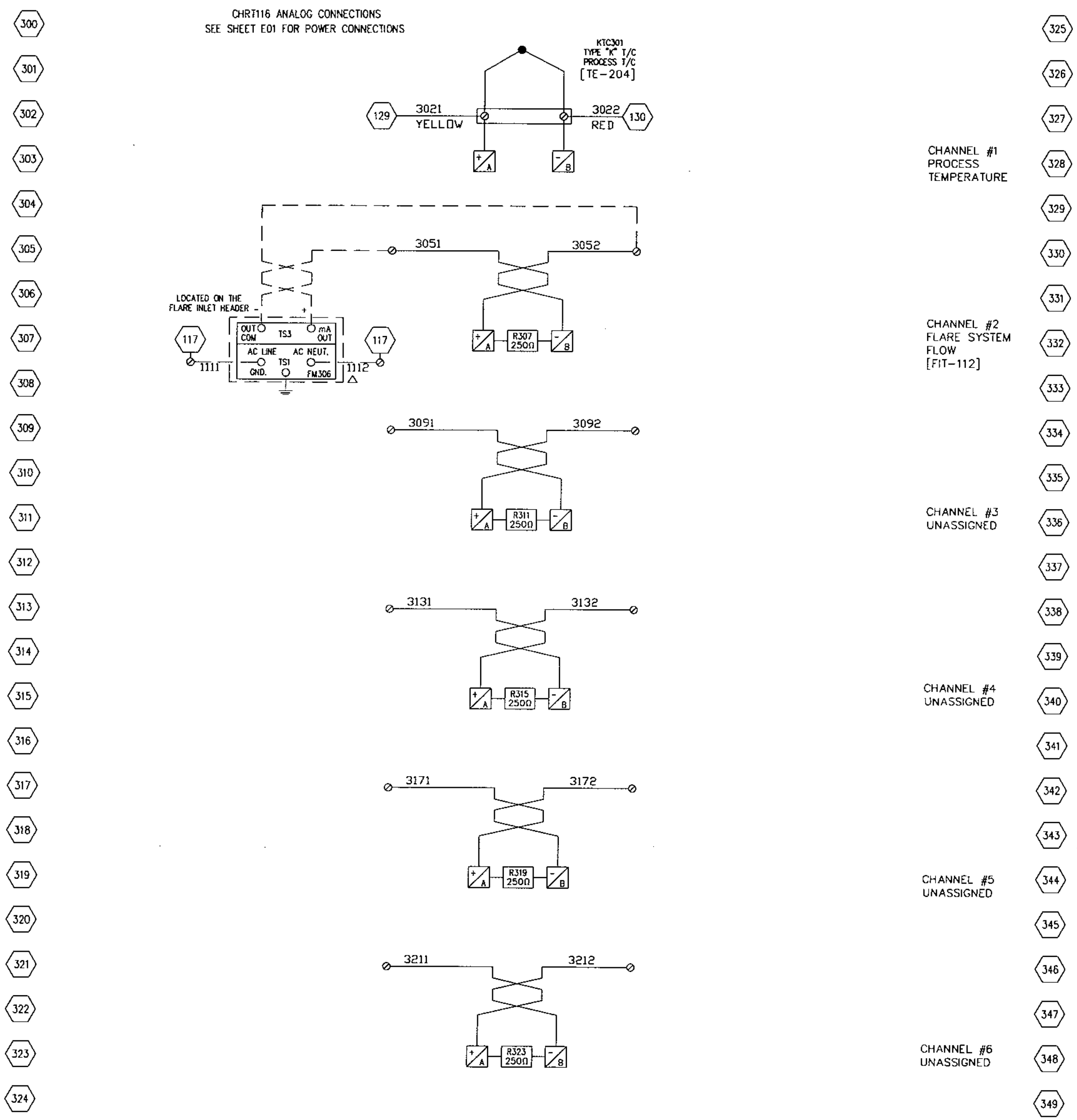

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FLAME-TROL I
CONTROL PANEL SCHEMATIC - CHART RECORDER

DRAWN BY	CHECKED	APPROVED BY	SIZE
R. MCQUILLEN	J. SCHROEDER	R. SEGOVIA	D
SCALE: NONE	DATE: 10/05/06	PROJECT NO: 110157	

PROJECT NAME: LANDFILL GAS UTILITY FLARE #PCFT124110
RENTAL UNIT

CUSTOMER: RENTAL UNIT

SERIAL NO	DWG NO	SHT
2065	EC300	1

File: F:\LFG\2000 DRAWINGS\2065\ELECTRICAL\2065-EC300.dwg Layout: B SIZE User: randy.mcquillen Feb 08, 2007 - 9:07am

BILL OF MATERIALS

RELAYS AND ACCESORIES

ITEM	QTY	DESCRIPTION	MANUFACTURER	MANUFACTURER PART NO.	LFG PART NO.
MCR	1	MINI CONTACTOR (MASTER CONTROL RELAY) 16A CONTACTS 4NO	GE	MC1A400ATJ	ECRMST-5
CR132	1	RELAY 4PDT 120VAC WITH INDICATING LIGHTS	OMRON	MY4IN AC110/120	ER4PDT5A-L-M
CR134	1	RELAY 4PDT 120VAC WITH INDICATING LIGHTS	OMRON	MY4IN AC110/120	ER4PDT5A-L-M
CR136	1	RELAY 4PDT 120VAC WITH INDICATING LIGHTS	OMRON	MY4IN AC110/120	ER4PDT5A-L-M
CR137	1	RELAY 4PDT 120VAC WITH INDICATING LIGHTS	OMRON	MY4IN AC110/120	ER4PDT5A-L-M
CR137A	1	RELAY 4PDT 120VAC WITH INDICATING LIGHTS	OMRON	MY4IN AC110/120	ER4PDT5A-L-M
CR139	1	RELAY 4PDT 120VAC WITH INDICATING LIGHTS	OMRON	MY4IN AC110/120	ER4PDT5A-L-M
CR144	1	RELAY 4PDT 120VAC WITH INDICATING LIGHTS	OMRON	MY4IN AC110/120	ER4PDT5A-L-M
CR148	1	RELAY 4PDT 120VAC WITH INDICATING LIGHTS	OMRON	MY4IN AC110/120	ER4PDT5A-L-M
CR207	1	RELAY 4PDT 120VAC WITH INDICATING LIGHTS	OMRON	MY4IN AC110/120	ER4PDT5A-L-M
CR210	1	RELAY 4PDT 120VAC WITH INDICATING LIGHTS	OMRON	MY4IN AC110/120	ER4PDT5A-L-M
CR211	1	RELAY 4PDT 120VAC WITH INDICATING LIGHTS	OMRON	MY4IN AC110/120	ER4PDT5A-L-M
CR214	1	RELAY 4PDT 120VAC WITH INDICATING LIGHTS	OMRON	MY4IN AC110/120	ER4PDT5A-L-M
CR215	1	RELAY 4PDT 120VAC WITH INDICATING LIGHTS	OMRON	MY4IN AC110/120	ER4PDT5A-L-M
CR217	1	RELAY 4PDT 120VAC WITH INDICATING LIGHTS	OMRON	MY4IN AC110/120	ER4PDT5A-L-M
CR227	1	RELAY 4PDT 120VAC WITH INDICATING LIGHTS	OMRON	MY4IN AC110/120	ER4PDT5A-L-M
CR240	1	RELAY 4PDT 120VAC WITH INDICATING LIGHTS	OMRON	MY4IN AC110/120	ER4PDT5A-L-M
SPARE	1	RELAY 4PDT 120VAC WITH INDICATING LIGHTS	OMRON	MY4IN AC110/120	ER4PDT5A-L-M
TMP129	1	RELAY 4PDT 120VAC WITH INDICATING LIGHTS	OMRON	MY4IN AC110/120	ER4PDT5A-L-M
TMP130	1	RELAY 4PDT 120VAC WITH INDICATING LIGHTS	OMRON	MY4IN AC110/120	ER4PDT5A-L-M
-	19	RELAY SOCKET (FOR 8598650000)	WEIDMULLER	8614350000	ERBASE
TR106	1	DIGITAL DIAL TIMER ON DELAY DPDT	ALLEN-BRADLEY	700-HRM12TA17	ET700HRM12TA17
TR135	1	DIGITAL DIAL TIMER ON DELAY DPDT	ALLEN-BRADLEY	700-HRM12TA17	ET700HRM12TA17
TR204	1	DIGITAL DIAL TIMER ON DELAY DPDT	ALLEN-BRADLEY	700-HRM12TA17	ET700HRM12TA17
TR205	1	LCD DISPLAY MULTI-MODE TIMER SPST	ALLEN-BRADLEY	700-HX86SA17	ET700HX86SA17
TR212	1	LCD DISPLAY MULTI-MODE TIMER SPST	ALLEN-BRADLEY	700-HX86SA17	ET700HX86SA17
TR218	1	DIGITAL DIAL TIMER ON DELAY DPDT	ALLEN-BRADLEY	700-HRM12TA17	ET700HRM12TA17
-	3	8 PIN SOCKET BACK MOUNT DIN RAIL (FOR ROTARY TIMER)	ALLEN-BRADLEY	700-HN125	ET700HN125
-	2	DOOR MOUNTING BRACKET FOR 700 SERIES TIMER	ALLEN-BRADLEY	700-HN130	ET700HN130
-	1	8 PIN SOCKET BACK MOUNT DIN RAIL (FOR LCD TIMER)	ALLEN-BRADLEY	700-HN100	ERB8BSCR
-	2	8 PIN REAR WIRE TIMER BASE	OMRON	P3GA-8	ECTP3G

TERMINALS AND DISTRIBUTION BLOCKS

ITEM	QTY	DESCRIPTION	MANUFACTURER	MANUFACTURER PART NO.	LFG PART NO.
1	4	TERMINAL BLOCK 22-12AWG 600 VAC WDU 2.5 BIEGE	WEIDMULLER	1020000000	EWDU2.5BI
2	25	TERMINAL BLOCK 22-12AWG 600 VAC WDU 2.5 BLUE	WEIDMULLER	1020080000	EWDU2.5BL
3	67	TERMINAL BLOCK 22-12AWG 600 VAC WDU 2.5 RED	WEIDMULLER	1020040000	EWDU2.5RT
4	9	TERMINAL BLOCK 22-12AWG 600 VAC WDU 2.5 WHITE	WEIDMULLER	1036800000	EWDU2.5WS
5	2	TYPE "K" T/C TERMINAL WDU 2.5/TC	WEIDMULLER	1024100000	ETB121/C-W
S204	1	WTR 2.5 KNIFE SWITCH ISOLATION BLOCK	WEIDMULLER	1011100000	FLOOR STOCK
6	2	TERMINAL BLOCK END PLATE WAP 2.5-10	WEIDMULLER	1050000000	FLOOR STOCK
7	14	TERMINAL BLOCK END BLOCK WEW 35/2	WEIDMULLER	1061200000	FLOOR STOCK
-	46"	DIN RAIL TS 35x7.5 (5mm SLOT)	WEIDMULLER	0514500000	FLOOR STOCK
-	4	JUMPERS FOR WDU 2.5 TERMINALS WQV2.5/10	WEIDMULLER	1054460000	FLOOR STOCK
-	13	BLANK TERMINAL LABELS FOR 5mm WS12/5 10 TAGS EACH	WEIDMULLER	1061060000	FLOOR STOCK
GND(PE)	1	GROUND BAR	GE	TGK12	FLOOR STOCK

INDICATORS BUTTONS SWITCHES & ACCESORIES

ITEM	QTY	DESCRIPTION	MANUFACTURER	MANUFACTURER PART NO.	LFG PART NO.
KSS122	1	KEY SWITCH SELECTOR (MASTER OFF/ON)	GE	CR104PSK21A91M	ESW2PMK-GE
PB122	1	RED MUSHROOM ILLUMINATED (E-STOP) PUSH/PULL BUTTON	GE	CR104PBT02R5C2	EPBESTOP
PB138	1	N.O. & N.C. MOMENTARY PUSHBUTTON (RESET)	GE	CR104PBG91B1	EPB1BLK-S
SS132	1	3 POSITION ROTARY SWITCH (CONTROL MODE MAN/OFF/AUTO)	GE	CR104PSG34B92	ESW3PM2CB
SS220	1	3 POSITION ROTARY SWITCH (PILOT GAS OFF/ON/IGNITE)	GE	CR104PSG86B92	ESW3PS2CB
		(CONT.) SPRING RETURN FROM RIGHT			
SS228	1	2 POSITION ROTARY SWITCH (HEADER VALVE CLOSE/OPEN)	GE	CR104PSG21B91	ESW2PM1CB
SS229	1	3 POSITION ROTARY SWITCH (BLOWER #1 MAN/OFF/AUTO)	GE	CR104PSG34B91	ESW3PM1CB
PL123	1	WHITE PUSH TO TEST PILOT LIGHT	GE	CR104PLT32W	EPL120VT6-W
PL141	1	RED PUSH TO TEST PILOT LIGHT	GE	CR104PLT32R	EPL120VT6-R
PL142	1	RED PUSH TO TEST PILOT LIGHT	GE	CR104PLT32R	EPL120VT6-R
PL146	1	RED PUSH TO TEST PILOT LIGHT	GE	CR104PLT32R	EPL120VT6-R
PL147	1	RED PUSH TO TEST PILOT LIGHT	GE	CR104PLT32R	EPL120VT6-R
PL208	1	AMBER PUSH TO TEST PILOT LIGHT	GE	CR104PLT32M	EPL120VT6-A
PL220	1	AMBER PUSH TO TEST PILOT LIGHT	GE	CR104PLT32M	EPL120VT6-A
PL222	1	AMBER PUSH TO TEST PILOT LIGHT	GE	CR104PLT32M	EPL120VT6-A
PL228	1	GREEN PUSH TO TEST PILOT LIGHT	GE	CR104PLT32G	EPL120VT6-G
PL229	1	GREEN PUSH TO TEST PILOT LIGHT	GE	CR104PLT32G	EPL120VT6-G
PL242	1	RED PUSH TO TEST PILOT LIGHT	GE	CR104PLT32R	EPL120VT6-R

CIRCUIT BREAKERS

ITEM	QTY	DESCRIPTION	MANUFACTURER	MANUFACTURER PART NO.	LFG PART NO.
CB102	1	CIRCUIT BREAKER (15A)	GE	V07115	ECB15A1PD
CB105	1	CIRCUIT BREAKER (3A)	GE	V07103	ECB3A1PD
CB107	1	CIRCUIT BREAKER (4A)	GE	V37104	ECB4A1PD-L
CB221	1	CIRCUIT BREAKER (3A)	GE	V37103	ECB3A1PD-L

FLAME RELAY

ITEM	QTY	DESCRIPTION	MANUFACTURER	MANUFACTURER PART NO.	LFG PART NO.
UV202	1	ULTRA VIOLET (FLAME RELAY)	HONEYWELL	RM7823A1016	EUVRELAY2
UV202	1	ULTRA VIOLET (FLAME AMP)	HONEYWELL	R7849A1023	EUVRELAY2AMP
UV202	1	ULTRA VIOLET (MOUNTING BASE)	HONEYWELL	Q7800A1005	EUVRELAY2BASE

TEMPERATURE CONTROL & ACCESORIES

ITEM	QTY	DESCRIPTION	MANUFACTURER	MANUFACTURER PART NO.	LFG PART NO.
CHRT116	1	6 CHANNEL PAPERLESS CHART RECORDER	YOKAGAWA	FX-106-4-2 /C3 /C7 /M1	ECRFX106
R307-323	5	250 OHM 1/4 WATT .1% PRECISION RESISTOR 0216J RN60C	DALE	2500B	FLOOR STOCK
PT128	1	DIGITAL CONTROLLER (UDC 1202)	HONEYWELL	DC120211101000	EUDC1200

PANEL INSTRUMENTATION

ITEM	QTY	DESCRIPTION	MANUFACTURER	MANUFACTURER PART NO.	LFG PART NO.
AMP112	1	0-5A RMS AC PROBE CONTROLLER (AMP METER)	TEXMATE	DL40-DR-PS1-IA05-R2	EAMPMTR
HM231	1	HOUR METER	REDINGTON	53202000	EAHOURMTR

MISCELLANEOUS

ITEM	QTY	DESCRIPTION	MANUFACTURER	MANUFACTURER PART NO.	LFG PART NO.
SUPP104	1	SURGE SUPPRESSOR	SQUARE D	SDSA1175	ESA10120V
-	1	SURGE SUPPRESSOR MOUNTING BRACKET	SQUARE D	QOSAMK	ESAMK
T107	1	300VA ISOLATION TRANSFORMER	GE	9T58K2911	GEISOTRNS
GFCI110	1	GFCI W/ BLANK FACE	PASS & SEYMOUR	2081-I	EGFCI-DF
GFCI110	1	SINGLE GANG HANDY BOX	RACO	660	ERECEPT120VBOX
RECPTAD	1	SINGLE GANG DUPLEX RECEPTACLE	HUBBELL	5362	EHUBHBL5362
RECPTAD	1	SINGLE GANG HANDY BOX	RACO	660	ERECEPT120VBOX
RECPTAD	1	RECEPTACLE COVER	STEEL CITY	58C7	FLOOR STOCK
-	2	1/2" CHASE NIPPLES	APPLETON	CNN-100	FLOOR STOCK
-	2	1/2" PLASTIC BUSHINGS	APPLETON	L-100	FLOOR STOCK
-	2	1/2" CONDUIT NUTS	APPLETON	PB-100-0	FLOOR STOCK

CABINET & ENCLOSURE

ITEM	QTY	DESCRIPTION	MANUFACTURER	MANUFACTURER PART NO.	LFG PART NO.
-	1	CONTROL PANEL ENCLOSURE STD FT ENCLOSURE 48x 36x 16	HOFFMAN	CSD483616	EBX48X36X16N4
-	216"	2"x 3" WIREWAY	PANDUIT	F2X3WH6	EWW2X3-WH
-	216"	2" WIREWAY COVER	PANDUIT	C2WH6	EWWC2-WH
HTR105	1	PANEL MOUNT 200W HEATER UNIT	HOFFMAN	DAH2001A	EHTR200
-	1	LARGE DOCUMENT HOLDER	HOFFMAN	ADP2	EBXDOC/DP2
-	1	BACKPLATE 36x 48	HOFFMAN	CP4836	EBX4836P
-	2	PAD LOCKABLE HANDLE	HOFFMAN	CWHPTO	EBXHNDL
-	1	HINGED WINDOW KIT	HOFFMAN	AWDH2430N4	EBXWNKIT
-	1	MOUNTING FEET FOR ENCLOSURE	HOFFMAN	C-MFKSS	EBXMTGFTR

Shaw® LFG Specialties, L.L.C.

REV	DESCRIPTION / ISSUE	DATE	BY
0	AS FABRICATED	02/06/07	REM

FLAME-TROL I
CONTROL PANEL BOM

DRAWN BY	CHECKED	APPROVED BY	SIZE
R. MCQUILLEN	J. SCHROEDER	R. SEGOVIA	D

SCALE	DATE	PROJECT NO.
NONE	10/05/06	110157

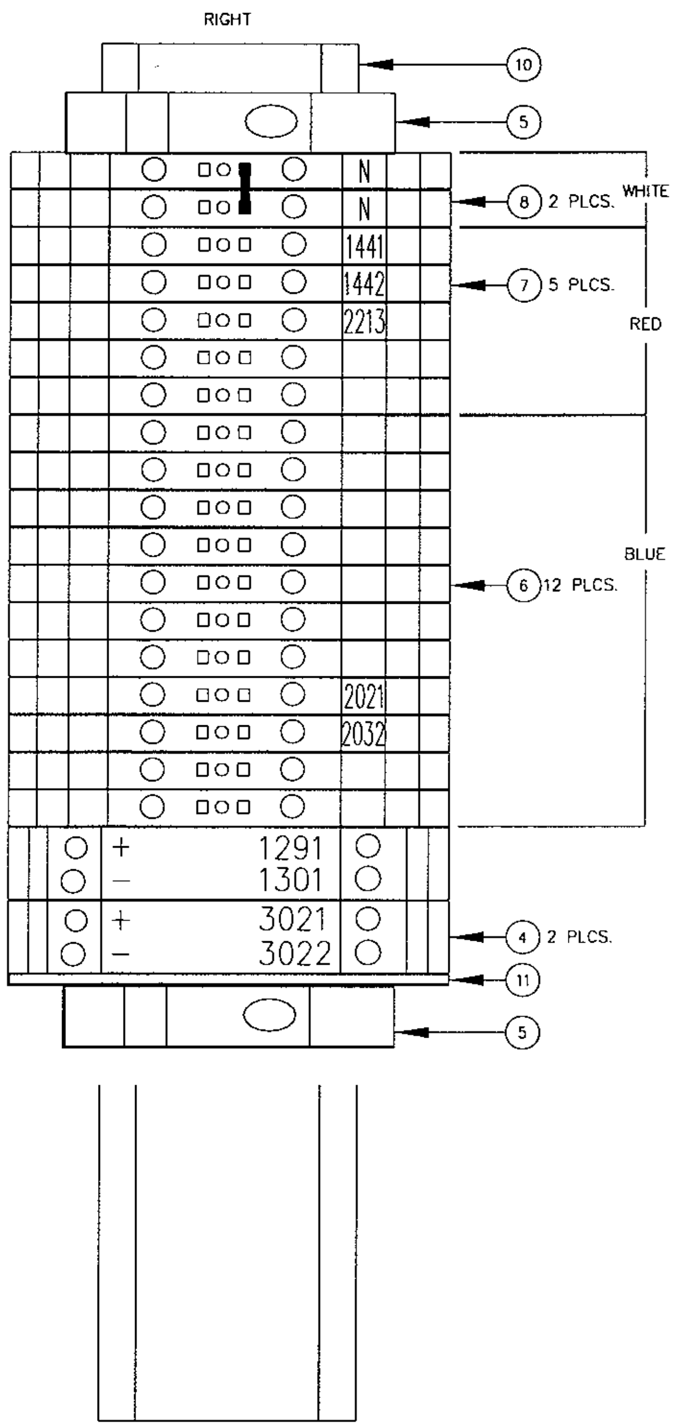
PROJECT NAME: LANDFILL GAS UTILITY FLARE #PCFT124210
RENTAL UNIT

CUSTOMER	SERIAL NO.	DWG NO.	SHT
RENTAL UNIT	2065	ECB	1

File: F:\LFG\2000 DRAWINGS\2065\ELECTRICAL\2065-ECB.dwg Layout: B SIZE User: randy.mcquillen Feb 08, 2007 - 9:07am

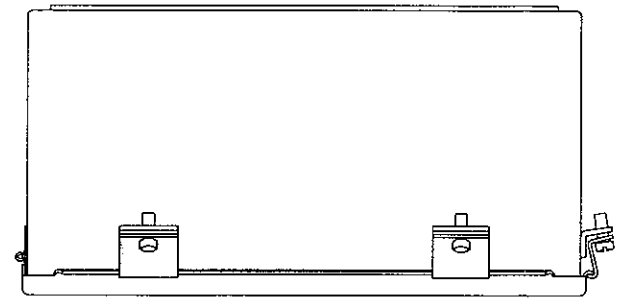
BILL OF MATERIAL

ITEM	QTY	DESCRIPTION	MANUFACTURER	SUPPLIER	PART NO.
1	1	ENCLOSURE NEMA 4 14x 12x 6	HOFFMAN	A-1412CHNF	EBX14X12N4
2	1	ENCLOSURE PLATE 14 x 12	HOFFMAN	A-14P12	EBX14X12P
3	1	150 VA IGNITION TRANSFORMER (120 VAC PRI. 6 kVAC SEC.)	FRANCEFORMER	6EEGW-2	EIGNTRNS
4	2	TYPE "K" T/C TERMINAL WDU 2.5/TC	WEIDMULLER	1024100000	ETB12TC-W
5	2	TERMINAL BLOCK END BLOCK WEW 35/2	WEIDMULLER	1061200000	FLOOR STOCK
6	12	TERMINAL BLOCK 22-12AWG 600 VAC WDU 2.5 BLUE	WEIDMULLER	1020080000	EWDU2.5BL
7	5	TERMINAL BLOCK 22-12AWG 600 VAC WDU 2.5 RED	WEIDMULLER	1020040000	EWDU2.5RT
8	2	TERMINAL BLOCK 22-12AWG 600 VAC WDU 2.5 WHITE	WEIDMULLER	1038000000	EWDU2.5WS
9	1	GROUND BAR	GE	TGK04	FLOOR STOCK
10	10"	DIN RAIL TS 35x7.5 (5mm SLOT)	WEIDMULLER	0514500000	FLOOR STOCK
11	1	TERMINAL BLOCK END PLATE WAP 2.5-10	WEIDMULLER	1050000000	FLOOR STOCK
	2	BLANK TERMINAL LABELS FOR 5mm WS12/5 10 TAGS EACH	WEIDMULLER	1061060000	FLOOR STOCK



TS DETAIL

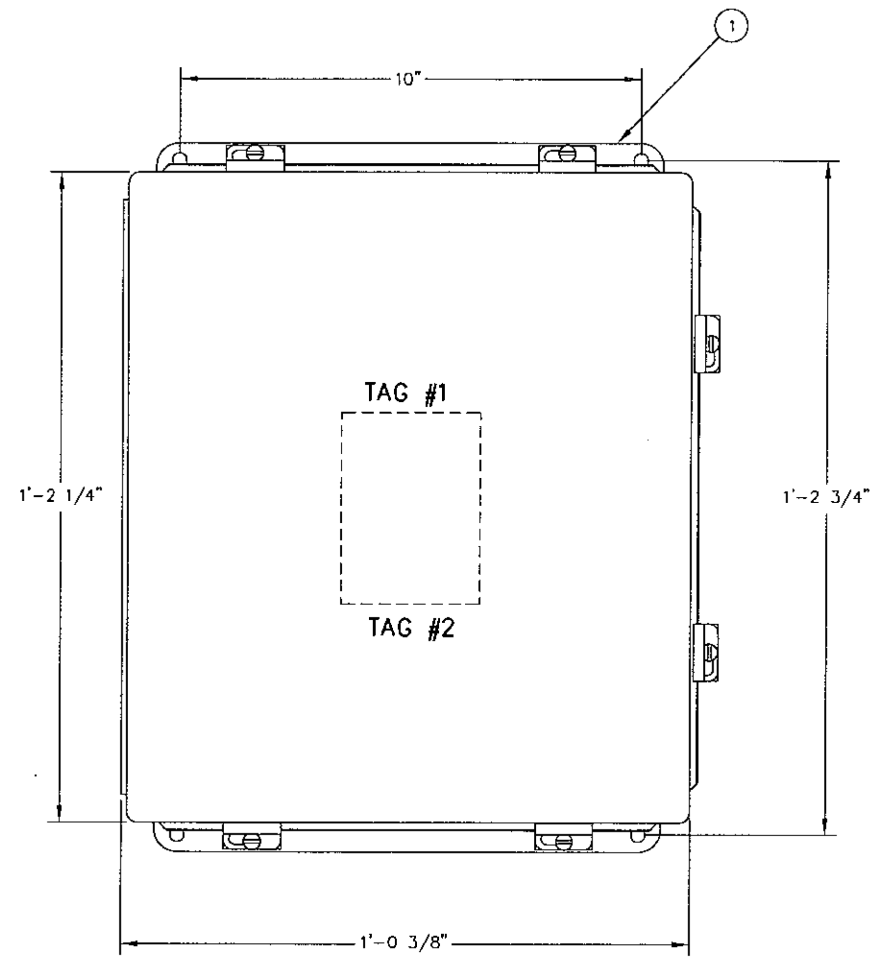
SCALE: DOUBLE



ENCLOSURE PROFILE

(PLAN)

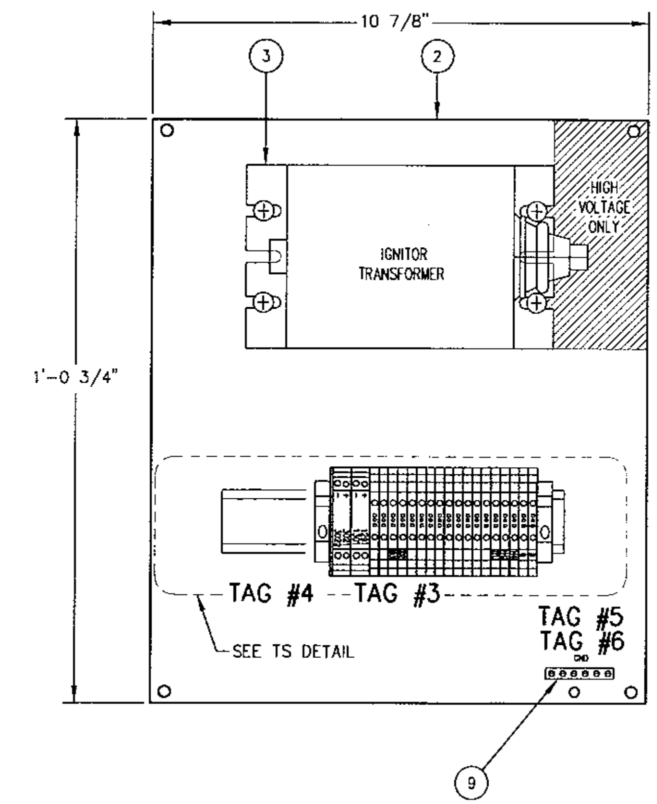
SCALE: 2:1



FRONT VIEW OF ENCLOSURE

(ELEVATION)

SCALE: 2:1



BACKPLATE OF ENCLOSURE

SCALE: 2:1

TAG #1

Shaw LFG SPECIALTIES
16406 U.S. RTE. 224 EAST
FINDLAY, OH 45840-9761
(419) 424-4999
(800) 225-6464

FLAME CONTROL PANEL (J-BOX)
MODEL NO. FLAMETROL I
SERIAL NO. 2065
PANEL: CF J-BOX

VOLTS - 120VAC, PHASE - 1PH
FREQ - 60HZ

Wiring Diagram: 2065-EC200
Date Code: 10/2006

TAG #2

TAG #3

WEIDMULLER WDU2.5
TORQUE TO
7.1 lb-in

TAG #4

WEIDMULLER WDU2.5/TC
TORQUE TO
7.1 lb-in

TAG #5

GROUND

TAG #6

GE TGK04
TORQUE TO
30 lb-in

Shaw® LFG Specialties, L.L.C.

REV	DESCRIPTION / ISSUE	DATE	BY
0	AS FABRICATED	02/06/07	REM

SYMBOL LEGEND

⊘	TERMINAL POINT (BACK PLATE)
⊠	TERMINAL POINT (SWING DOOR)
△	SKID MOUNTED DEVICES
— — —	SKID WIRING
———	14 GA. WIRE

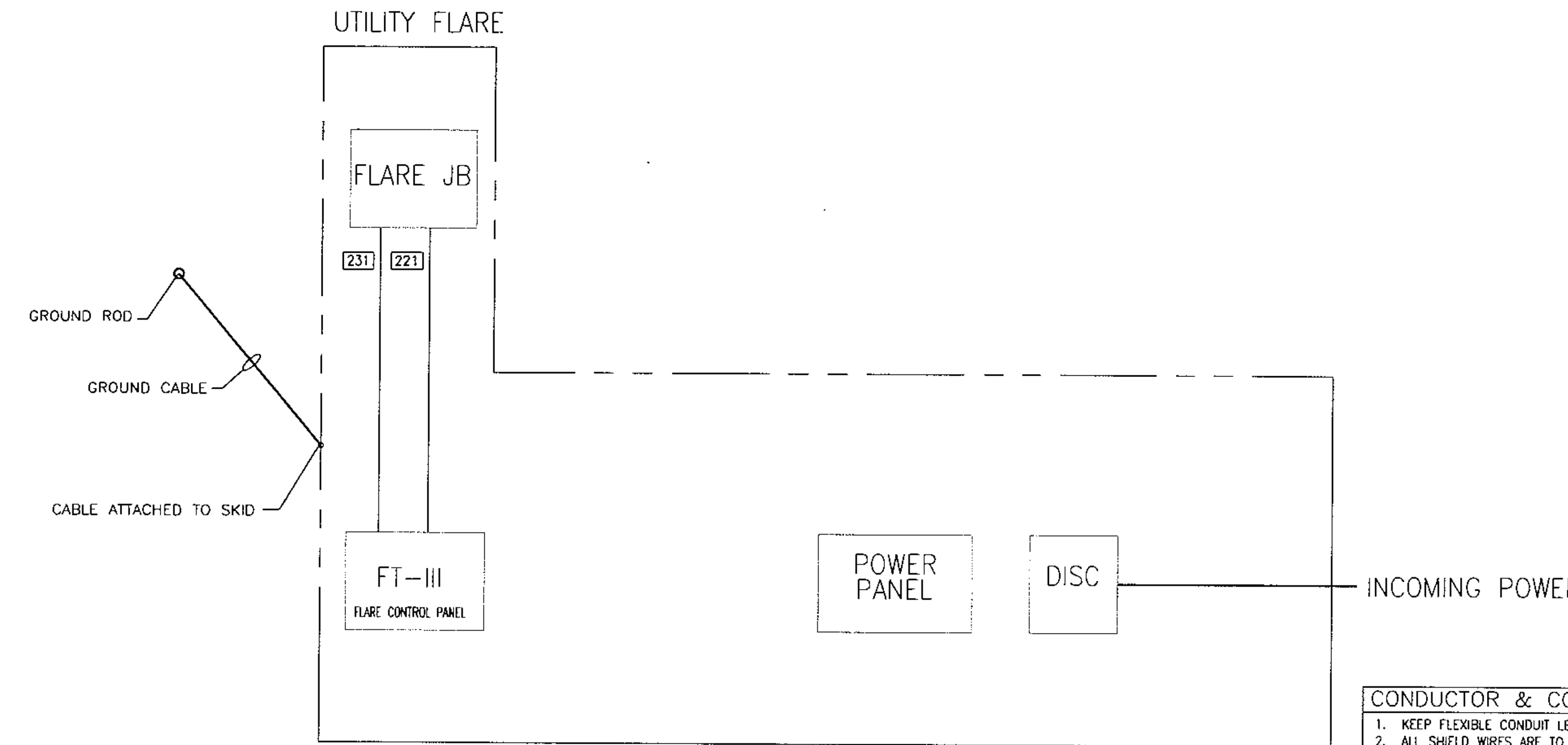
FLARE JUNCTION BOX ASSEMBLY & BOM

DRAWN BY:	CHECKED:	APPROVED BY:	SIZE:
R. MCQUILLEN	J. SCHROEDER	R. SEGOVIA	D
SCALE: AS SHOWN	DATE: 10/05/06	PROJECT NO: 110157	

PROJECT NAME: LANDFILL GAS UTILITY FLARE #PCFT124210 RENTAL UNIT

CUSTOMER	SERIAL NO.	DWG NO.	SHT.	REV.
RENTAL UNIT	2065	EJ1	1	1

File: F:\LFG\2000 DRAWINGS\2065\ELECTRICAL\2065-EJ1.dwg Layout: B SIZE User: randy.mcquillen Feb 08, 2007 - 9:08am



NOTE:
ITEMS SHOWN IN BOLD ARE TO BE INSTALLED PRIOR TO SYSTEM START-UP

CONDUCTOR & CONDUIT NOTES

1. KEEP FLEXIBLE CONDUIT LENGTHS BETWEEN 18"-36".
2. ALL SHIELD WIRES ARE TO BE TIED AT PANEL END ONLY
3. ALL CONTROL I/O SHALL BE #14 AWG THWN UNLESS OTHERWISE INDICATED.
4. BELDEN 8761 OR EQUIVELENT IS RECOMMENDED FOR ANALOG SIGNALS.
5. ALL CONDUCTORS ARE SIZED FOR LENGTHS OF 100' OR LESS.
6. TYPE "K" T/C CABLE IS RECOMMENDED TO BE OMEGA EXPP-K-20 OR EQ.
7. ALL CONDUCTOR SIZING IS VALID FOR CONDUIT LENGTHS OF 100 FEET OR LESS.
8. ALL MOTOR CIRCUIT CONDUCTORS SHALL NOT BE LESS THAN #12 AWG THWN.
9. ALL GROUNDING CONDUCTORS SHALL NOT BE LESS THAN #12 AWG THHN.
10. ALL CONDUCTORS AND CONDUITS SHALL BE SIZED AND INSTALLED PER LOCAL, STATE & NATIONAL CODES.
11. ALL CONDUCTOR SIZING IS BASED ON THWN INSULATION.
12. ALL WIRING & METHOD SHALL BE SUITABLE FOR WET LOCATION.
13. SEAL-OFFS ARE REQUIRED ON ALL BURIED CONDUIT.
14. THE USE OF A COMMON GROUNDING SYSTEM IS REQUIRED, UTILIZING GROUND GRID(S) OR RODS AS REQUIRED BY ALL LOCAL, STATE, & NFPA/70 ARTICLE 250 AND IEEE-142 (GREEN BOOK) REGULATIONS. ADDITIONALLY, GROUND RESISTANCE SHALL NOT EXCEED 25 OHMS, AND 15 OHMS OR LESS IS PREFERRED. THE FLARE STACK AND BLOWER SKID MUST BE CASE GROUNDED.

WIRE COLOR CODE

SIGNAL	COLOR
DC	BLUE
120VAC	RED
NEUTRAL (120VAC)	WHITE
POWER CONNECTIONS	BLACK
EXTERNALLY POWERED	YELLOW
INTRINSICALLY SAFE	LT BLUE

CONDUIT NUMBERING SYSTEM

1ST DIGIT (REGION)
0= PRIMARY POWER SUPPLY
1= MOTOR CONTROL\POWER DIST.
2= FLARE CONTROL PANEL
3= BLOWER SKID
4= FLARING EQUIPMENT
5= GAS UTILIZATION EQUIPMENT #1
6= GAS UTILIZATION EQUIPMENT #2

2ND DIGIT (SIGNAL TYPE)
1= MOTOR & POWER DISTRIBUTION
2= DIGITAL
3= ANALOG
4= MIXED SIGNALS

3RD DIGIT & 4TH DIGITS (NUMBER OF CONDUIT IN A LOCATION)
I.E. 121 = 1ST DIGITAL CONDUIT TO LEAVE CONTROL/DISTRIBUTION AREA
122 = 2ND DIGITAL CONDUIT TO LEAVE CONTROL/DISTRIBUTION AREA
1111 = 11TH POWER CONDUIT TO LEAVE MCC/DISTRIBUTION AREA AREA

CONDUIT LEGEND

RIGID
FLEXIBLE
FIELD INSTALLED RIGID
FIELD INSTALLED FLEX CONDUIT
FUTURE RIGID (FIELD INSTALLED)
FUTURE FLEX (FIELD INSTALLED)

Shaw® LFG Specialties, L.L.C.

REV	DESCRIPTION / ISSUE	DATE	BY
0	AS FABRICATED	02/06/07	REM

CONDUIT LEGEND

RIGID
FLEXIBLE
FUTURE RIGID
FUTURE FLEXIBLE
FUTURE OR FIELD INSTALLED RIGID
FUTURE OR FIELD FLEX CONDUIT

SHOP & FIELD WIRING DIAGRAM - SIMPLIFIED

DRAWN BY:	ENGINEER:	APPROVED BY:	SIZE:
R. MCQUILLEN	J. SCHROEDER	R. SEGOVIA	O

SCALE	DATE:	PROJECT NO:
NONE	10/05/06	110157

PROJECT NAME: LANDFILL GAS UTILITY FLARE #PCFT124210 RENTAL UNIT

CUSTOMER	SERIAL NO.	DWG NO.	SHT
RENTAL UNIT	2065	EW1	1

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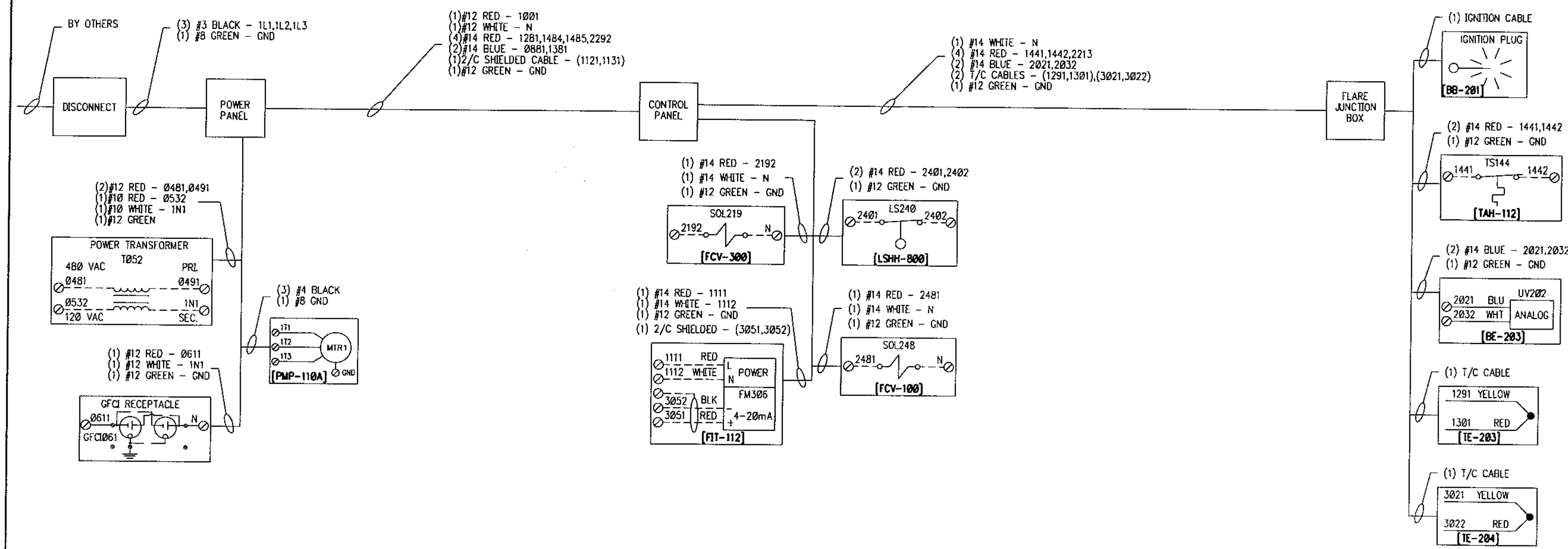

CONDUCTOR & CONDUIT NOTES

1. KEEP FLEXIBLE CONDUIT LENGTHS BETWEEN 18"-36".
2. ALL SHIELD WIRES ARE TO BE TIED AT PANEL END ONLY
3. ALL CONTROL I/O SHALL BE #14 AWG THWN UNLESS OTHERWISE INDICATED.
4. BELDEN 8761 OR EQUIVELENT IS RECOMMENDED FOR ANALOG SIGNALS.
5. ALL CONDUCTORS ARE SIZED FOR LENGTHS OF 100' OR LESS.
6. TYPE "K" T/C CABLE IS RECOMMENDED TO BE OMEGA EXPP-K-20 OR EQ.
7. ALL CONDUCTOR SIZING IS VALID FOR CONDUIT LENGTHS OF 100 FEET OR LESS.
8. ALL MOTOR CIRCUIT CONDUCTORS SHALL NOT BE LESS THAN #12 AWG THWN.
9. ALL GROUNDING CONDUCTORS SHALL NOT BE LESS THAN #12 AWG THHN.
10. ALL CONDUCTORS AND CONDUITS SHALL BE SIZED AND INSTALLED PER LOCAL, STATE & NATIONAL CODES.
11. ALL CONDUCTOR SIZING IS BASED ON THWN INSULATION.
12. ALL WIRING & METHOD SHALL BE SUITABLE FOR WET LOCATION.
13. SEAL-OFFS ARE REQUIRED ON ALL BURIED CONDUIT.
14. THE USE OF A COMMON GROUNDING SYSTEM IS REQUIRED, UTILIZING GROUND GRID(S) OR RODS AS REQUIRED BY ALL LOCAL, STATE, & NFPA/70 ARTICLE 250 AND IEEE-142 (GREEN BOOK) REGULATIONS. ADDITIONALLY, GROUND RESISTANCE SHALL NOT EXCEED 25 OHMS, AND 15 OHMS OR LESS IS PREFERRED. THE FLARE STACK AND BLOWER SKID MUST BE CASE GROUNDED.

WIRE COLOR CODE

SIGNAL	COLOR
DC	BLUE
120VAC	RED
NEUTRAL (120VAC)	WHITE
POWER CONNECTIONS	BLACK
EXTERNALLY POWERED	YELLOW
INTRINSICALLY SAFE	LT BLUE

Shaw® LFG Specialties, L.L.C.

REV	DESCRIPTION / ISSUE	DATE	BY
0	AS FABRICATED	02/06/07	REM

SHOP & FIELD WIRING INTERCONNECTION DIAGRAM

DRAWN BY:	ENGINEER:	APPROVED BY:	SIZE:
R. MCQUILLEN	J. SCHROEDER	R. SEGOVIA	D
SCALE: NONE	DATE: 10/05/06	PROJECT NO: 110157	

PROJECT NAME: LANDFILL GAS UTILITY FLARE #PCFT1242I10 RENTAL UNIT

CUSTOMER	SERIAL NO:	DWG NO:	SHT:
RENTAL UNIT	2065	EW2	1

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ATTACHMENT 10
CAAPP Permit No. 97030064

Attention:
Advanced Disposal Services Zion Landfill Inc.
Attn: Timothy D. Curry
701 Green Bay Road
Zion, Illinois 60099

State of Illinois

CLEAN AIR ACT PERMIT PROGRAM (CAAPP) PERMIT

Source:
Advanced Disposal Services Zion Landfill Inc.
701 Green Bay Road,
Zion, Illinois 60099

I.D. No.: 097200AAV
Permit No.: 97030064

Permitting Authority:
Illinois Environmental Protection Agency
Bureau of Air, Permit Section
217/785-1705

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY

1021 North Grand Avenue East, P.O. Box 19276, Springfield, Illinois 62794-9276 • (217) 782-3397
JB Pritzker, Governor John J. Kim, Acting Director

CLEAN AIR ACT PERMIT PROGRAM (CAAPP) PERMIT

Type of Application: Administrative Amendment (AA)
Purpose of Application: Revise Existing CAAPP Permit to add a Delegated Authority and to reflect a change in the Responsible Official and other contact information

ID No.: 097200AAV
Permit No.: 97030064

Permit renewal submitted to IEPA on September 19, 2019 by EIL. Site continues to operate under current permit until permit renewal is finalized/issued by the IEPA.

Date Application Received: February 7, 2007
Date Issued: June 24, 2015

Date Revision Received May 20, 2019
Date Revision Issued May 22, 2019

Expiration Date: June 24, 2020
Renewal Submittal Date: 9 Months Prior to June 24, 2020

Source Name: Advanced Disposal Services Zion Landfill, Inc.
Address: 701 Green Bay Road
City: Zion
County: Lake
ZIP Code: 60099

This permit is hereby granted to the above-designated source authorizing operation in accordance with this CAAPP permit, pursuant to the above referenced application. This source is subject to the conditions contained herein. If a conflict exists between this document and previous versions of the CAAPP permit, this document supersedes those terms and conditions of the permit for which the conflict exists. For further information on the source see Section 1 and for further discussion on the effectiveness of this permit see Condition 2.3(g).

If you have any questions concerning this permit, please contact Anthony P. Miller at 217/785-1705.

Raymond E Pilapil/wdm

Raymond E. Pilapil
Manager, Permit Section
Bureau of Air

REP:WDM:APM:jlp

cc: IEPA, Permit Section
IEPA, FOS, Region 1
Lotus Notes Database

Table of Contents

Section 1 - Source Information

1. Addresses

Source
Advanced Disposal Services Zion Landfill, Inc.
701 Green Bay Road
Zion, Illinois 60099

Owner
Advanced Disposal Services Zion Landfill, Inc.
701 Green Bay Road
Zion, Illinois 60099

Operator
Advanced Disposal Services Zion Landfill, Inc.
701 Green Bay Road
Zion, Illinois 60099

Permittee
The Owner and Operator of the source as identified in this table.

2. Contacts

Certified Officials

The source shall submit an Administrative Permit Amendment for any change in the Certified Officials, pursuant to Section 39.5(13) of the Act.

	Name	*Title*
Responsible Official	Dan Dewaard	Midwest Region Vice-President
Delegated Authority	Timothy D. Curry	Midwest Region Landfill Operations Manager

Other Contacts

	Name	*Phone No.*	*Email*
Source/Technical Contact, Correspondence and Billing	Timothy D. Curry	618-806-7392	tim.curry@advanceddisposal.com

3. Single Source

a. The source identified in Condition 1.1 above shall be defined to include all the following additional source(s):

I.D. No.	*Permit No.*	*Single Source Name and Address*
097200ABC	03070058	Bio Energy (Illinois) LLC. Zion Landfill Gas Power Station 701 Green Bay Road Zion, Illinois, 60099

Bio Energy (Illinois) LLC owns and operates a landfill gas to energy facility at ADS Zion Landfill under CAAPP Permit No. 03070058 and is considered to be a support facility for the landfill. ADS Zion Landfill and Bio Energy (Illinois) LLC have elected to obtain separate CAAPP permits.

b. **Construction Permit 01050045 Requirements [T1]**

i. Pursuant to Construction Permit 01050045, total emissions from the source, i.e., the combination of ADS Zion Landfill and Bio Energy (Illinois) LLC gas-to-energy facility (ID No. 097200ABC) - See Section 1.3(a), shall not exceed the following:

Pollutant	Emissions (Tons/year)
CO	247.5
SO_2	200.0

c. **Construction Permit 06100001 Requirements [T1]**

i. Pursuant to Construction Permit 06100001, total emissions from the source, i.e., emissions from ADS Zion Landfill's open and enclosed flares referenced in Condition 4.1.1, and Bio Energy (Illinois) LLC gas-to-energy facility (ID No. 097200ABC) - See Section 1.3(a), shall not exceed the following:

Pollutant	Limit (Tons/year)
NO_x	160
CO	247.5
SO_2	200
VOM	40.0
PM	15.0[1]
Total HAPs	8.0

1 This limit does not include fugitive PM emissions from the landfill roadways and soil stockpiles.

d. **Construction Permit 12070062 Requirements [T1]**

i. Pursuant to Construction Permit 12070062, the total emissions of the source, i.e., ADS Zion Landfill and Bio Energy (Illinois) LLC facility (ID No. 097200ABC) - See Section 1.3(a), excluding fugitive emissions, shall not exceed the following limits: [T1]

Pollutant	Applicable Rules*		Limit (Tons/Year)
	MSSCAM	PSD	
NO_x	Yes	Yes	126**
CO	No	Yes	225
SO_2	No	Yes	200
PM	No	Yes	200
PM_{10}	No	Yes	200
$PM_{2.5}$	No	Yes	80
VOM	Yes	No	80
NMOC	No	Yes	80

* These columns identify whether a pollutant is being limited, pursuant to both Construction Permit 12070062 and this permit, in order to address applicability of the MSSCAM or PSD rules, or both of these rules, to the expansion of the landfill authorized by Construction Permit 12070062.

** This NO_x limit is derived based on average past actual emissions of the existing source for the consecutive 24 month period and 32 tons/year of increase from the project described in Construction Permit 12070062, (i.e., 94 tons/year + 32 tons/year).

ii. Pursuant to Construction Permit 12070062, this permit is issued based on the source, i.e., ADS Zion Landfill (ID No 097200AAV) and Bio Energy (Illinois) LLC facility (ID No. 097200ABC) - See Section 1.3(a), not being a major source of emissions of hazardous air pollutants (HAPs). For this purpose, HAP emissions of the source shall not exceed 8 tons per year for any individual HAP and 20 tons per year of any combination of HAPs. [T1]

Note: This condition is intended to ensure that the affected source continues to not be a major source of HAP emissions for purposes of the NESHAP adopted by USEPA pursuant to Section 112(b) of the Clean Air Act.

e. **Emissions Reduction Market System (ERMS)**

i. Pursuant to 35 IAC Part 205.205(a), ERMS seasonal emissions of VOM from the source, i.e., ADS Zion Landfill and Bio Energy (Illinois) LLC facility (ID No. 097200ABC) - See Section 1.3(a), during the seasonal allotment period from May 1 through September 30 shall not exceed 15 tons, not including VOM emissions from insignificant emission units and activities as identified in Section 6 of this permit. The Permittee shall comply with all applicable requirements in Section 7.2 of this permit.

f. **Compliance Method**

Monitoring

i. Pursuant to Sections 39.5(7)(b) and (d) of the Act and Construction Permits 01050045, 06100001 and 12070062, the Permittee shall demonstrate compliance with the requirements in Condition 1.3(b) and (c), as follows:

A. ADS Zion Landfill shall demonstrate compliance with the emissions limitations in Conditions 1.3(b), (c) and (d) shall be verified utilizing the monitoring, recordkeeping, and reporting procedures used to calculate emissions for the emission units and operations covered under the respective sections of this permit, i.e., the monitoring, recordkeeping, and reporting in Section 4.0 and 6.0 of the permit.

B. ADS Zion Landfill shall demonstrate compliance with the emissions limitations in Condition 1.3(e) shall be verified utilizing the monitoring, recordkeeping, and reporting procedures, required in Section 7.2.

C. ADS Zion Landfill shall demonstrate compliance with the emissions limitations in Conditions 1.3(b), (c) and (d) shall be verified using site-specific data for the generation, disposition and composition of LFG and appropriate emission factors, which in order of preference for pollutants shall be factors from on-site emission testing, manufacturer's emission data, and emission factors from USEPA's Compilation of Air Pollutant Emission Factors (AP-42) with appropriate adjustments to this data and these emission factors to reflect source-specific conditions and any deficiencies in the collection of LFG and operation of units controlling LFG at this affected source. [T1]

D. Compliance with the source-wide annual emissions limitations in Conditions 1.3(b), (c) and (d) shall be based upon the sum of emissions from all applicable emission units and operations at ADS Zion Landfill (ID No 097200AAV) and Bio Energy (Illinois) LLC facility (ID No. 097200ABC), i.e., where compliance with annual limits shall be determined from a running total of 12 months of data, i.e., the sum of emissions data for each specific pollutant for the month of record plus the preceding 11 months of data. [T1]

Testing

ii. Pursuant to Sections 39.5(7)(b) and (d) of the Act, the ADS Zion Landfill LFG total reduced sulfur (TRS), net heat and NMOC/VOM content shall be determined based the procedures and schedules required in Conditions 4.1.2(b)(ii)(B) and the net heat content and NMOC/VOM testing and calculation procedures required in Conditions 4.1.2(c)(ii)(B) and (C). Where:

A. The net heating value of the landfill gas shall be calculated from the concentration of methane in the landfill gas as measured by Method 3C of Appendix A of 40 CFR Part 60.

B. Total reduced sulfur (TRS) concentration shall be determined as per Reference Method 15/16 or ASTM D5504.

C. NMOC/VOM content: Method 25, 25C, or Method 18 of Appendix A of 40 CFR Part 60 must be used to determine inlet NMOC concentration level, unless another method to demonstrate compliance has been approved by the Illinois EPA. If using Method 18 of Appendix A of this Part, the minimum list of compounds to be tested shall be those published in the most recent Compilation of Air Pollutant Emission Factors (AP-42). The Permittee may assume 100% of the NMOC emitted is VOM or provide credible evidence in the compliance demonstration of the fraction of VOM that is present, i.e., determine the VOM emission factor based on the removal of the organic compounds listed in 40 CFR 51.100(s)(1) or 35 IAC 211.7150 which have negligible chemical photoreactivity from the overall NMOC concentration.

For each landfill gas sampling and analysis activity from the active collection system, at least three representative samples of landfill gas shall be collected from the common header pipe before the gas moving or any condensate removal equipment.

Recordkeeping

iii. A. Pursuant to Sections 39.5(7)(b) and (e) of the Act, as applicable, the Permittee shall keep and maintain records and documentation of the assumptions and/or factors, and calculations used to demonstrate compliance with the source-wide limitations in limitations in Conditions 1.3(b), (c) and (d).

B. Pursuant to Construction Permits 11030009, the Permittee shall keep the following records related to emissions of the source:

I. The Permittee shall keep records for the amount of waste deposited in the original landfill and in the expansion, referenced in Construction Permits 11030009, on a yearly basis, further categorized by type of waste if differences in waste type are considered in determining the amount of LFG generated by the existing landfill and the expansion.

II. The Permittee shall keep the following records related to overall emissions of the Source:

1. (a) Calculations, on at least an annual basis, for the total amount of LFG generated by the affected landfill during the preceding year and the percentage of the LFG that is attributable to the existing landfill and to the expansion, referenced in Construction Permits 11030009.

(b) Amount of LFG (mmscf/month and mmscf/year) sent to the associated gas-to-energy facility, referenced in Condition 1.3(a), as fuel.

2. A file containing the emission factors used by the Permittee for calculating the landfill's emissions of NO_x, CO, SO_2, PM, PM_{10}, VOM, NMOC, and HAPs, with supporting documentation.

3. Records for the total amount of sulfur in collected LFG (tons/month and tons/year), with supporting calculations.

4. Records for emissions of NO_x, CO, SO_2, PM, PM_{10}, VOM, NMOC, and HAPs from the landfill, (tons/month and tons/year), with supporting calculations.

5. Records for the emissions of NO_x, CO, SO_2, PM, PM_{10}, VOM, NMOC, and HAPs the source, i.e., the combined emissions from the affected landfill and associated gas-to-energy facility, referenced in Condition 1.3(a), with supporting calculations, which records shall be compiled on at least a quarterly basis:

Note: For the emissions from the associated gas-to-energy facility, the Permittee may obtain a copy of the records from the operator of the facility on a routine basis, with supporting documentation and calculations.

6. Emissions of NO_x and SO_2 from combustion of LFG collected from the expansion, referenced in Construction Permits 11030009, tons/month and tons/year), with supporting documentation and calculations.

C. Pursuant to Construction Permits 12070062, the Permittee shall keep the following records related to emissions of the source:

I. 1. The Permittee shall keep records of the total amount of LFG collected from the affected landfill and its disposition, i.e., the amount of LFG sent to the gas-to-energy facility, referenced in Condition 1.3(a), and to each flare (scf/month and scf/year), referenced in Condition 4.1.4, with supporting documentation.

2. The Permittee shall keep monthly records of the split between LFG generated by the affected landfill that is attributable to the existing source, i.e., the landfill excluding the expansion authorized by Construction Permit 12070062, and LFG that is attributable to the expansion of the landfill authorized by this permit.

II. The Permittee shall keep the records related to the emissions of NO_x, CO, SO_2, PM, PM_{10}, VOM, NMOC, and HAPs of the affected source (tons/month and tons/year), i.e., the combined emissions attributable from the operation at the affected landfill and the gas-to-energy facility, referenced in Condition 1.3(a), with supporting calculations and compiled on a quarterly basis.

Note: For this purpose, for the emissions from the associated gas-to-energy facility, the Permittee may on a routine basis obtain a copy of the emission data from the operator of that facility, with supporting documentation and calculations.

Reporting

iv. A. Pursuant to Section 39.5(7)(f) of the Act, within 30 days of discovering a deviation from applicable requirements in Condition 1.3(b), (c), or (d), all such deviations shall be summarized and reported and also included as part of the Semiannual Monitoring Report required by Condition 3.6(b).

B. Pursuant to Section 39.5(7)(f) of the Act, the Permittee shall submit an annual compliance report, to the IEPA Air Compliance Section (See Attachment 2 for Addresses) by May 1 of the year following the calendar year of record. The report shall include a summary of the total monthly and the 12 month rolling total annual emissions from the source, i.e., ADS Zion Landfill and Bio Energy (Illinois) LLC facility, see Section 1.3(a), for each of the pollutants listed in Conditions 1.3(b), (c) and (d) for each calendar month based upon a running total of 12 months of data, i.e., the sum of emissions data for each specific pollutant for the month of record plus the preceding 11 months of data to the IEPA, Air Compliance Section (See Attachment 2 for Addresses).

Section 2 - General Permit Requirements

1.	**Prohibitions**

a. It shall be unlawful for any person to violate any terms or conditions of this permit issued under Section 39.5 of the Act, to operate the CAAPP source except in compliance with this permit issued by the IEPA under Section 39.5 of the Act or to violate any other applicable requirements. All terms and conditions of this permit issued under Section 39.5 of the Act are enforceable by USEPA and citizens under the Clean Air Act, except those, if any, that are specifically designated as not being federally enforceable in this permit pursuant to Section 39.5(7)(m) of the Act. [Section 39.5(6)(a) of the Act]

b. After the applicable CAAPP permit or renewal application submittal date, as specified in Section 39.5(5) of the Act, the source shall not operate this CAAPP source without a CAAPP permit unless the complete CAAPP permit or renewal application for such source has been timely submitted to the IEPA. [Section 39.5(6)(b) of the Act]

c. No Owner or Operator of the CAAPP source shall cause or threaten or allow the continued operation of an emission source during malfunction or breakdown of the emission source or related air pollution control equipment if such operation would cause a violation of the standards or limitations applicable to the source, unless this CAAPP permit granted to the source provides for such operation consistent with the Act and applicable Illinois Pollution Control Board regulations. [Section 39.5(6)(c) of the Act]

d. Pursuant to Section 39.5(7)(g) of the Act, emissions from the source are not allowed to exceed any allowances that the source lawfully holds under Title IV of the Clean Air Act or the regulations promulgated thereunder, consistent with Section 39.5(17) of the Act and applicable requirements, if any.

2.	**Emergency Provisions**

Pursuant to Section 39.5(7)(k) of the Act, the Owner or Operator of the CAAPP source may provide an affirmative defense of emergency to an action brought for noncompliance with technology-based emission limitations under this CAAPP permit if the following conditions are met through properly signed, contemporaneous operating logs, or other relevant evidence:

a. i. An emergency occurred and the source can identify the cause(s) of the emergency.

ii. The source was at the time being properly operated.

iii. The source submitted notice of the emergency to the IEPA within 2 working days of the time when emission limitations were exceeded due to the emergency. This notice must contain a detailed description of the emergency, any steps taken to mitigate emissions, and corrective actions taken.

iv. During the period of the emergency the source took all reasonable steps to minimize levels of emissions that exceeded the emission limitations, standards, or requirements in this permit.

b. For purposes of Section 39.5(7)(k) of the Act, "emergency" means any situation arising from sudden and reasonably unforeseeable events beyond the control of the source, such as an act of God, that requires immediate corrective action to restore normal operation, and that causes the source to exceed a technology-based emission limitation under this permit, due to unavoidable increases in emissions attributable to the emergency. An emergency shall not include noncompliance to the extent caused by improperly designed equipment, lack of preventive maintenance, careless or improper operation, or operation error.

c. In any enforcement proceeding, the source seeking to establish the occurrence of an emergency has the burden of proof. This provision is in addition to any emergency or upset provision contained in any applicable requirement. This provision does not relieve the source of any reporting obligations under existing federal or state laws or regulations.

3. General Provisions

a. **Duty to Comply**

The source must comply with all terms and conditions of this permit. Any permit noncompliance constitutes a violation of the CAA and the Act, and is grounds for any or all of the following: enforcement action; permit termination, revocation and reissuance, or modification; or denial of a permit renewal application. [Section 39.5(7)(o)(i) of the Act]

b. **Need to Halt or Reduce Activity is not a Defense**

It shall not be a defense for the source in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this permit. [Section 39.5(7)(o)(ii) of the Act]

c. **Duty to Maintain Equipment**

The source shall maintain all equipment covered under this permit in such a manner that the performance or operation of such equipment shall not cause a violation of applicable requirements. [Section 39.5(7)(a) of the Act]

d. **Disposal Operations**

The source shall be operated in such a manner that the disposal of air contaminants collected by the equipment operations, or activities shall not cause a violation of the Act or regulations promulgated there under. [Section 39.5(7)(a) of the Act]

e. **Duty to Pay Fees**

i. The source must pay fees to the IEPA consistent with the fee schedule approved pursuant to Section 39.5(18) of the Act, and submit any information relevant thereto. [Section 39.5(7)(o)(vi) of the Act]

ii. The IEPA shall assess annual fees based on the allowable emissions of all regulated air pollutants, except for those regulated air pollutants excluded in Section 39.5(18)(f) of the Act and insignificant activities in Section 6, at the source during the term of this permit. The amount of such fee shall be based on the information supplied by the applicant in its complete CAAPP permit application. [Section 39.5(18)(a)(ii)(A) of the Act]

iii. The check should be payable to "Treasurer, State of Illinois" and sent to: Fiscal Services Section, Illinois EPA, P.O. Box 19276, Springfield, IL, 62794-9276. Include on the check: ID #, Permit #, and "CAAPP Operating Permit Fees". [Section 39.5(18)(e) of the Act]

f. **Obligation to Allow IEPA Surveillance**

Pursuant to Sections 4(a), 39.5(7)(a), and 39.5(7)(p)(ii) of the Act, inspection and entry requirements that necessitate that, upon presentation of credentials and other documents as may be required by law and in accordance with constitutional limitations, the source shall allow the IEPA, or an authorized representative to perform the following:

i. Enter upon the source's premises where the emission unit(s) are located or emissions-related activity is conducted, or where records must be kept under the conditions of this permit.

ii. Have access to and copy, at reasonable times, any records that must be kept under the conditions of this permit.

iii. Inspect at reasonable times any facilities, equipment (including monitoring and air pollution control equipment), practices, or operations regulated or required under this permit.

iv. Sample or monitor any substances or parameters at any location at reasonable times:

A. As authorized by the Clean Air Act or the Act, at reasonable times, for the purposes of assuring compliance with this CAAPP permit or applicable requirements; or

B. As otherwise authorized by the Act.

v. Enter and utilize any photographic, recording, testing, monitoring, or other equipment for the purposes of preserving, testing, monitoring, or recording any activity, discharge or emission at the source authorized by this permit.

g. **Effect of Permit**

i. Pursuant to Section 39.5(7)(j)(iv) of the Act, nothing in this CAAPP permit shall alter or affect the following:

A. The provisions of Section 303 (emergency powers) of the CAA, including USEPA's authority under that Section.

B. The liability of the Owner or Operator of the source for any violation of applicable requirements prior to or at the time of permit issuance.

C. The applicable requirements of the acid rain program consistent with Section 408(a) of the Clean Air Act.

D. The ability of USEPA to obtain information from the source pursuant to Section 114 (inspections, monitoring, and entry) of the Clean Air Act.

ii. Notwithstanding the conditions of this permit specifying compliance practices for applicable requirements, pursuant to Sections 39.5(7)(j) and (p) of the Act, any person (including the Permittee) may also use other credible evidence to establish compliance or noncompliance with applicable requirements. [35 IAC 201.122 and Section 39.5(7)(a) of the Act]

h. **Severability Clause**

The provisions of this permit are severable. In the event of a challenge to any portion of this permit, other portions of this permit may continue to be in effect. Should any portion of this permit be determined to be illegal or unenforceable, the validity of the other provisions shall not be affected and the rights and obligations of the source shall be construed and enforced as if this permit did not contain the particular provisions held to be invalid and the applicable requirements underlying these provisions shall remain in force. [Section 39.5(7)(i) of the Act]

4. Testing

a. Tests conducted to measure composition of materials, efficiency of pollution control devices, emissions from process or control equipment, or other parameters shall be conducted using standard test methods if applicable test methods are not specified by the applicable regulations or otherwise identified in the conditions of this permit. Documentation of the test date, conditions, methodologies, calculations, and test results shall be retained pursuant to the recordkeeping procedures of this permit. Reports of any tests conducted as required by this permit or as the result of a request by the IEPA shall be submitted as specified in Condition 7.1 of this permit. [35 IAC Part 201 Subpart J and Section 39.5(7)(a) of the Act]

b. Pursuant to Section 4(b) of the Act and 35 IAC 201.282, every emission source or air pollution control equipment shall be subject to the following testing requirements for the purpose of determining the nature and quantities of specified air contaminant emissions and for the purpose of determining ground level and ambient air concentrations of such air contaminants:

i. Testing by Owner or Operator: The IEPA may require the Owner or Operator of the emission source or air pollution control equipment to conduct such tests in accordance with procedures adopted by the IEPA, at such reasonable times as may be specified by the IEPA and at the expense of the Owner or Operator of the emission source or air pollution control equipment. All such tests shall be made by or under the direction of a person qualified by training and/or experience in the field of air pollution testing. The IEPA shall have the right to observe all aspects of such tests.

ii. Testing by the IEPA: The IEPA shall have the right to conduct such tests at any time at its own expense. Upon request of the IEPA, the Owner or Operator of the emission source or air pollution control equipment shall provide, without charge to the IEPA, necessary holes in stacks or ducts and other safe and proper testing facilities, including scaffolding, but excluding instruments and sensing devices, as may be necessary.

5. Recordkeeping

a. **Control Equipment Maintenance Records**

Pursuant to Section 39.5(7)(b) of the Act, a maintenance record shall be kept on the premises for each item of air pollution control equipment. At a minimum, this record shall show the dates maintenance was performed and the nature of preventative maintenance activities.

b. **Retention of Records**

i. Records of all monitoring data and support information shall be retained for a period of at least 5 years from the date of the monitoring sample, measurement, report, or application. Support information includes all calibration and maintenance records, original strip-chart recordings for continuous monitoring instrumentation, and copies of all reports required by this permit. [Section 39.5(7)(e)(ii) of the Act]

ii. Pursuant to Section 39.5(7)(a) of the Act, other records required by this permit including any logs, plans, procedures, or instructions required to be kept by this permit shall be retained for a period of at least 5 years from the date of entry unless a different period is specified by a particular permit provision.

c. **Availability of Records**

i. Pursuant to Section 39.5(7)(a) of the Act, the Permittee shall retrieve and provide paper copies, or as electronic media, any records retained in an electronic format (e.g., computer) in response to an IEPA or USEPA request during the course of a source inspection.

ii. Pursuant to Section 39.5(7)(a) of the Act, upon written request by the IEPA for copies of records or reports required to be kept by this permit, the Permittee shall promptly submit a copy of such material to the IEPA. For this purpose, material shall be submitted to the IEPA within 30 days unless additional time is provided by the IEPA or the Permittee believes that the volume and nature of requested material would make this overly burdensome, in which case, the Permittee shall respond within 30 days with the explanation and a schedule for submittal of the requested material. (See also Condition 2.9(d))

6. Certification

a. **Compliance Certification**

i. Pursuant to Section 39.5(7)(p)(v)(C) of the Act, the source shall submit annual compliance certifications by May 1 unless a different date is specified by an applicable requirement or by a particular permit condition. The annual compliance certifications shall include the following:

A. The identification of each term or condition of this permit that is the basis of the certification.

B. The compliance status.

C. Whether compliance was continuous or intermittent.

D. The method(s) used for determining the compliance status of the source, both currently and over the reporting period consistent with the conditions of this permit.

ii. Pursuant to Section 39.5(7)(p)(v)(D) of the Act, all compliance certifications shall be submitted to the IEPA Compliance Section. Address is included in Attachment 2.

iii. Pursuant to Section 39.5(7)(p)(i) of the Act, all compliance reports required to be submitted shall include a certification in accordance with Condition 2.6(b).

b. **Certification by a Responsible Official**

Any document (including reports) required to be submitted by this permit shall contain a certification by the responsible official of the source that meets the requirements of Section 39.5(5) of the Act and applicable regulations. [Section 39.5(7)(p)(i) of the Act]. An example Certification by a Responsible Official is included in Attachment 3 of this permit.

7. Permit Shield

a. Pursuant to Section 39.5(7)(j) of the Act, except as provided in Condition 2.7(b) below, the source has requested and has been granted a permit shield. This permit shield provides that compliance with the conditions of this permit shall be deemed compliance with applicable requirements which were applicable as of the date the proposed permit for this source was issued, provided that either the applicable requirements are specifically identified within this permit, or the IEPA, in acting on this permit application, has determined that other requirements specifically identified are not applicable to this source and this determination (or a concise summary thereof) is included in this permit. This permit shield does not extend to applicable requirements which are promulgated after May 5, 2015 (date USEPA notice started), unless this permit has been modified to reflect such new requirements.

b. Pursuant to Section 39.5(7)(j) of the Act, this permit and the terms and conditions herein do not affect the Permittee's past and/or continuing obligation with respect to statutory or regulatory requirements governing major source construction or modification under Title I of the CAA. Further, neither the issuance of this permit nor any of the terms or conditions of the permit shall alter or affect the liability of the Permittee for any violation of applicable requirements prior to or at the time of permit issuance.

c. Pursuant to Section 39.5(7)(a) of the Act, the issuance of this permit by the IEPA does not and shall not be construed as barring, diminishing, adjudicating or in any way affecting any currently pending or future legal, administrative or equitable rights or claims, actions, suits, causes of action or demands whatsoever that the IEPA or the USEPA may have against the applicant including, but not limited to, any enforcement action authorized pursuant to the provision of applicable federal and state law.

8. Title I Conditions

Pursuant to Sections 39(a), 39(f), and 39.5(7)(a) of the Act, as generally identified below, this CAAPP permit may contain certain conditions that relate to requirements arising from the construction or modification of emission units at this source. These requirements derive from permitting programs authorized under Title I of the Clean Air Act (CAA) and regulations thereunder, and Title X of the Illinois Environmental Protection Act (Act) and regulations implementing the same. Such requirements, including the New Source Review programs for both major (i.e., PSD and nonattainment areas) and minor sources, are implemented by the IEPA.

a. This permit may contain conditions that reflect requirements originally established in construction permits previously issued for this source. These conditions include requirements from preconstruction permits issued pursuant to regulations approved or promulgated by USEPA under Title I of the CAA, as well as requirements contained within construction permits issued pursuant to state law authority under Title X of the Act. Accordingly, all such conditions are incorporated into this CAAPP permit by virtue of being either an "applicable Clean Air Act requirement" or an "applicable requirement" in accordance with Section 39.5 of the Act. These conditions are identifiable herein by a designation to their origin of authority.

b. This permit may contain conditions that reflect necessary revisions to requirements established for this source in preconstruction permits previously issued under the authority of Title I of the CAA. These conditions are specifically designated herein as "TIR."

   i. Revisions to original Title I permit conditions are incorporated into this permit through the combined legal authority of Title I of the CAA and Title X of the Act. Public participation requirements and appeal rights shall be governed by Section 39.5 of the Act.

   ii. Revised Title I permit conditions shall remain in effect through this CAAPP permit, and are therefore enforceable under the same, so long as such conditions do not expire as a result of a failure to timely submit a complete renewal application or are not removed at the applicant's request.

c. This permit may contain conditions that reflect new requirements for this source that would ordinarily derive from a preconstruction permit established under the authority of Title I of the CAA. These conditions are specifically designated herein as "TIN."

   i. The incorporation of new Title I requirements into this CAAPP permit is authorized through the combined legal authority of Title I of the CAA and Title X of the Act. Public participation requirements and appeal rights shall be governed by Section 39.5 of the Act.

   ii. Any Title I conditions that are newly incorporated shall remain in effect through this CAAPP permit, and are therefore enforceable under the same, so long as such conditions do not expire as a result of a failure to timely submit a complete renewal application or are not removed at the applicant's request.

9. Reopening and Revising Permit

a. **Permit Actions**

   This permit may be modified, revoked, reopened and reissued, or terminated for cause in accordance with applicable provisions of Section 39.5 of the Act. The filing of a request by the source for a permit modification, revocation and reissuance, or termination, or of a notification of planned changes or anticipated noncompliance does not stay any permit condition. [Section 39.5(7)(o)(iii) of the Act]

b. **Reopening and Revision**

Pursuant to Section 39.5(15)(a) of the Act, this permit must be reopened and revised if any of the following occur:

i. Additional requirements become applicable to the equipment covered by this permit and three or more years remain before expiration of this permit;

ii. Additional requirements become applicable to the source for acid deposition under the acid rain program;

iii. The IEPA or USEPA determines that this permit contains a material mistake or that an inaccurate statement was made in establishing the emission standards or limitations, or other terms or conditions of this permit; or

iv. The IEPA or USEPA determines that this permit must be revised or revoked to ensure compliance with the applicable requirements.

c. **Inaccurate Application**

Pursuant to Sections 39.5(5)(e) and (i) of the Act, the IEPA has issued this permit based upon the information submitted by the source in the permit application referenced on page 1 of this permit. Any misinformation, false statement or misrepresentation in the application shall be grounds for revocation or reopening of this CAAPP under Section 39.5(15) of the Act.

d. **Duty to Provide Information**

The source shall furnish to the IEPA, within a reasonable time specified by the IEPA any information that the IEPA may request in writing to determine whether cause exists for modifying, revoking and reissuing, or terminating this permit, or to determine compliance with this permit. Upon request, the source shall also furnish to the IEPA copies of records required to be kept by this permit. [Section 39.5(7)(o)(v) of the Act]

10. Emissions Trading Programs

No permit revision shall be required for increases in emissions allowed under any USEPA approved economic incentives, marketable permits, emissions trading, and other similar programs or processes for changes that are provided for elsewhere in this permit and that are authorized by the applicable requirement. [Section 39.5(7)(o)(vii) of the Act]

11. Permit Renewal

a. Upon the expiration of this permit, if the source is operated, it shall be deemed to be operating without a permit unless a timely and complete CAAPP application has been submitted for renewal of this permit. However, if a timely and complete application to renew this CAAPP permit has been submitted, the terms and all conditions of the most recent issued CAAPP permit will remain in effect until the issuance of a renewal permit. [Sections 39.5(5)(l) and (o) of the Act]

b. For purposes of permit renewal, a timely application is one that is submitted no less than 9 months prior to the date of permit expiration. [Section 39.5(5)(n) of the Act]

12. Permanent Shutdown

Pursuant to Section 39.5(7)(a) of the Act, this permit only covers emission units and control equipment while physically present at the source location(s). Unless this permit specifically provides for equipment relocation, this permit is void for the operation or activity of any item of equipment on the date it is removed from the permitted location(s) or permanently shut down. This permit expires if all equipment is removed from the permitted location(s), notwithstanding the expiration date specified on this permit.

13. Startup, Shutdown, and Malfunction

Pursuant to Section 39.5(7)(a) of the Act, in the event of an action to enforce the terms or conditions of this permit, this permit does not prohibit a Permittee from invoking any affirmative defense that is provided by the applicable law or rule.

Section 3 - Source Requirements

1. Applicable Requirements

Pursuant to Sections 39.5(7)(a), 39.5(7)(b), and 39.5(7)(d) of the Act, the Permittee shall comply with the following applicable requirements. These requirements are applicable to all emission units (including insignificant activities unless specified otherwise in this Section) at the source.

a. **Fugitive Particulate Matter**

i. **Applicable Requirement(s)**

A. Pursuant to 35 IAC 212.301, no person shall cause or allow the emission of fugitive particulate matter from any process, including any material handling or storage activity, that is visible by an observer looking generally toward the zenith at a point beyond the property line of the source, unless the exception for wind speed greater than 25 mph is demonstrated in accordance with 35 IAC 212.314.

B. I. Pursuant to Section 39.5(7)(a) of the Act and Construction Permit 12070062, the Permittee shall follow good air pollution control practices to minimize fugitive particulate matter emissions, i.e., dust, from roads, parking areas, and other open areas at the source affected by wind erosion and/or re-entrainment, at each area of the landfill with the potential to generate significant quantities of fugitive particulate matter emissions. [T1]

II. Pursuant to Section 39.5(7)(a) of the Act and Construction Permit 12070062, in order to minimize fugitive particulate matter emissions from landfill operations under Condition 3.1(a)((i)(B)(I), the Permittee shall implement and maintain control measures. These measures may include: pavement on all regularly traveled entrances and exits to the landfill and treatment (sweeping, application of water, use of dust suppressants, etc., when necessary) of paved and unpaved roads and areas that are routinely subject to vehicle traffic. [T1]

ii. Compliance Method

Monitoring

A. Pursuant to Construction Permit 12070062, the Permittee shall inspect quarterly to verify proper implementation of the fugitive dust control program requirements in Condition 3.1(a)(i)(B). [T1]

Pursuant to Sections 39.5(7)(b) and (d) of the Act, if fugitive particulate matter emissions are observed during the quarterly inspection, the Permittee shall take corrective action in accordance with the control measures record as incorporated by reference in Condition 3.2(a), within 2 hours to return the affected area of the landfill to the status of no fugitive particulate matter emissions beyond the property line of the source.

Testing

B. Pursuant to Sections 39.5(7)(b) and (d) of the Act, upon request by the Illinois EPA, the Permittee shall conduct observations at the property line of the source for visible emissions of fugitive particulate matter from the landfill activities with an observation period of at least one (1) minute. For this purpose, daily observations shall be conducted for at least seven calendar days for particular area(s) of concern at the source, as specified in the request, observations shall begin either within one day or three days of receipt of a written request from the Illinois EPA, depending, respectively, upon whether observations will be conducted by employees of the Permittee or a third-party observer hired by the Permittee to conduct observations on its behalf. The Permittee shall keep records for these observations in accordance with Condition 3.1(a)(ii)(C)(III).

Recordkeeping

C. I. Pursuant to Sections 39.5(7)(b) and (e) of the Act, the Permittee shall maintain a record identifying the control measures that the Permittee elects to use to comply with Condition 3.1(a)(i)(B). The Permittee shall keep a copy of the most recent control measures record on site with all previous amendments or revisions, and it shall include the following information:

1. A map or diagram showing the location of all fugitive particulate matter emissions generating activities and/or where control measures are typically applied on a regular basis, including the location, identification, length, and width of roadways, and volume and nature of expected traffic or other activity;

2. Description of the standard control measures including type of measure, frequency and, if applicable, application rates;

3. Description of any secondary control measures that would be used based on circumstances (freezing temperatures, recent rain, dry weather, etc.) with identification of the circumstances in which they would be used and identify any triggers for implementation of additional control measures, e.g., presence of extended dust plumes following passage of vehicles, with description of those additional dust control measures;

4. Description of corrective actions that will be implemented in the event of visible emissions across the property line and/or observation of areas affected by wind erosion and/or re-entrainment. Such corrective action may include but is not limited to the application of a protective cover on landfill surfaces, the spraying of surfactant solution or water on a regular basis, or other equivalent treatment methods;

5. Assumptions and/or observations regarding the quantity and nature of vehicle traffic at the source as related to source operations.

II. Pursuant to Sections 39.5(7)(b) and (e) of the Act and Construction Permit 12070062, shall maintain following records related to the control of fugitive dust from the affected landfill.

1. Records documenting implementation of dust control measures.

2. Records for the periodic inspections required by Condition 3.1(a)(ii)(A). The records shall include

(a) Date and time of the inspection and/or observations were performed;

(b) Name(s) of observing personnel and their affiliation;

(c) Identification of type of inspection and/or observations, i.e., compliance inspections pursuant to Condition 3.1(a)(ii)(A) and/or observations request by the Illinois EPA pursuant to Condition 3.1(a)(ii)(B);

(d) Identification of the activity and/or property line which was observed;

(e) The total elapsed time for each observation, i.e., the observation period;

(f) If a demonstration for exception from 35 IAC 212.301 is being made, wind speed data as required by 35 IAC 212.314, with an indication as to where the data was obtained; and

(g) The findings of the observer including whether an inspection of activities was necessary as a result of observed fugitive particulate matter emissions and/or to verify implementation of the control measures record

iii. Records for incidents when control measures were not carried out as scheduled or were not fully implemented and incidents when additional control measures were carried out, with description of each such incident and explanation. These records shall address any adjustments to the scheduling of control measures made by the Permittee due to weather conditions that either acted to reduce or increase the level of potential dust, such as precipitation or extended periods of dry weather.

b. **Ozone Depleting Substances**

Pursuant to 40 CFR 82.150(b), the Permittee shall comply with the standards for recycling and emissions reduction of ozone depleting substances pursuant to 40 CFR Part 82, Subpart F, except as provided for motor vehicle air conditioners in Subpart B of 40 CFR Part 82:

i. Pursuant to 40 CFR 82.156, persons opening appliances for maintenance, service, repair, or disposal must comply with the required practices.

ii. Pursuant to 40 CFR 82.158, equipment used during the maintenance, service, repair, or disposal of appliances must comply with the standards for recycling and recovery equipment.

iii. Pursuant to 40 CFR 82.161, persons performing maintenance, service, repair, or disposal of appliances must be certified by an approved technician certification program.

iv. Pursuant to 40 CFR 82 Subpart B, any person performing service on a motor vehicle for consideration when this service involves the refrigerant in the motor vehicle air conditioner shall comply with 40 CFR 82 Subpart B, Servicing of Motor Vehicle Air Conditioners.

v. Pursuant to 40 CFR 82.166, all persons shall comply with the reporting and recordkeeping requirements of 40 CFR 82.166.

c. **Asbestos Demolition and Renovation**

i. Asbestos Fees. Pursuant to Section 9.13(a) of the Act, for any site for which the Owner or Operator must file an original 10-day notice of intent to renovate or demolish pursuant to Condition 3.1(c)(ii) below and 40 CFR 61.145(b), the owner or operator shall pay to the IEPA with the filing of each 10-day notice a fee of $150.

ii. Pursuant to 40 CFR 61 Subpart M, Standard of Asbestos, prior to any demolition or renovation at this facility, the Permittee shall fulfill notification requirements of 40 CFR 61.145(b).

iii. Pursuant to 40 CFR 61.145(c), during demolition or renovation, the Permittee shall comply with the procedures for asbestos emission control established by 40 CFR 61.145(c).

d. **NSPS/NESHAP for Municipal Solid Waste Landfills**

i. Pursuant to the definitions in 40 CFR 60.751 and 63.1990, the ADS Zion Landfill (Section 4.1) is considered to be a "municipal solid waste landfill or MSW landfill" for purposes of compliance with 40 CFR Part 60 Subpart WWW - Standards of Performance for Municipal Solid Waste Landfills and 40 CFR Part 63 Subpart AAAA – National Emission Standards for Hazardous Air Pollutants: Municipal Solid Waste Landfills.

ii. Pursuant to 39.5(7)(a) and (b) of the Act, for purposes of compliance with 40 CFR Part 60 Subpart WWW and 40 CFR Part 63 Subpart AAAA, documentation and data required in Section 4.1 for ADS Zion Landfill shall be included in, applicable compliance records and/or reports, required under 40 CFR Part 60 Subpart WWW and 40 CFR Part 63 Subpart AAAA, shown in Section 4.1.

e. Future **Emission Standards**

Pursuant to Section 39.5(15)(a) of the Act, this source shall comply with any new or revised applicable future standards of 40 CFR 60, 61, 62, or 63; or 35 IAC Subtitle B after the date issued of this permit. The Permittee shall, in accordance with the applicable regulation(s), comply with the applicable requirements by the date(s) specified and shall certify compliance with the applicable requirements of such regulation(s) as part of the annual compliance certification, as required by Condition 2.6(a). This permit may also have to be revised or reopened to address such new regulations in accordance to Condition 2.9.

2. Applicable Plans and Programs

Pursuant to Sections 39.5(7)(b) and (d) of the Act, the Permittee shall comply with the following requirements.

a. Control Measures Record

i. Pursuant to Sections 39.5(7)(b) and (e) of the Act, the Control Measures record shall be amended from time to time by the Permittee so that the Control Measures record is current. Any future revision to the Control Measures record shall be submitted to the Illinois EPA within 30 days of such amendment.

ii. Pursuant to Sections 39.5(7)(b) and (e) of the Act, the Control Measures record, as submitted by the Permittee on April 24, 2015, is incorporated herein by reference. Any future revision made by the Permittee during the permit term is automatically incorporated by reference provided the revision is not expressly disapproved, in writing, by the Illinois EPA within 30 days of receipt of the revision.

iii. Pursuant to Sections 39.5(7)(b) and (e) of the Act, the Permittee shall submit to the Illinois EPA not later than 60 days after the effectiveness of Condition 3.1(a)(ii)(C)(I), an updated copy of the Control Measures record submitted on April 24, 2015. Upon request by the Agency, the Permittee shall submit other relevant information related to the control practices.

Note: The incorporation of the record of control measures into this permit is for the sole purpose of providing an enforceable component to the Permittee's obligation, as set forth in Condition 3.1(a)(i)(B)(II), to implement and maintain control measures as necessary to minimize fugitive particulate matter emissions. This incorporation by reference does not provide an independent basis to enforce against the Permittee's selection of control measures and/or alleged noncompliance with 35 IAC 212.301.

b. **Episode Action Plan**

i. Pursuant to 35 IAC 244.141, the Permittee shall have on file with the IEPA an Episode Action Plan for reducing the levels of emissions during yellow alerts, red alerts, and emergencies, consistent with safe operating procedures. The Episode Action Plan shall contain the information specified in 35 IAC 244.144.

ii. The Permittee shall immediately implement the appropriate steps described in the Episode Action Plan should an air pollution alert or emergency be declared, as required by 35 IAC 244.169, or as may otherwise be required under 35 IAC 244, Appendix D.

iii. Pursuant to 35 IAC 244.143(d), if an operational change occurs at the source which invalidates the Episode Action Plan, a revised Episode Action Plan shall be submitted to the IEPA for review within 30 days of the change and is automatically incorporated by reference provided the revision is not expressly disapproved, in writing, by the IEPA within 30 days of receipt of the revision. In the event that the IEPA notifies the Permittee of a deficiency with any revision to the Episode Action Plan, the Permittee shall be required to revise and resubmit the Episode Action Plan within 30 days of receipt of notification to address the deficiency pursuant to Section 39.5(7)(a) of the Act.

iv. The Episode Action Plan, as submitted by the Permittee on November 21, 2014, is incorporated herein by reference. The document constitutes the formal Episode Action Plan required by 35 IAC 244.142, addressing the actions that will be implemented to reduce SO_2, PM_{10}, NO_2, CO and VOM emissions from various emissions units in the event of a yellow alert, red alert or emergency issued under 35 IAC 244.161 through 244.165.

v. Pursuant to Section 39.5(7)(b) of the Act, the Permittee shall keep a copy of the Episode Action Plan, any amendments or revisions to the Episode Action Plan (as required by Condition 3.2(b)(iii)), and the Permittee shall also keep a record of activities completed according to the Episode Action Plan.

3. Title I Requirements

As of the date of issuance of this permit, other than the source-wide Title limitations on combined emissions from both Zion landfill and Bio Energy (Illinois) LLC in Condition 1.3(b), there are no other source-wide Title I requirements that need to be included in this Condition.

4. Synthetic Minor Limits

As of the date of issuance of this permit, there are no source-wide synthetic minor limits that need to be included in this Condition.

5. Source-wide Non-Applicability Determinations

a. Pursuant to 35 IAC 212.302(a) and (b), the operations at this source are not subject to 35 IAC 212.304 through 212.310 and 212.312 because, respectively, the operations at the source are not designated as being applicable based upon the sources SIC code (35 IAC 212.302(a)) and because it is not located in the geographical areas defined in 35 IAC 212.324(a)(1), respectively.

Should this source become subject to 35 IAC 212.302, the Permittee shall prepare and operate under a Fugitive PM Operating Program consistent with 35 IAC 212.310 and submitted to the IEPA for its review. The Fugitive PM Operating Program shall be designed to significantly reduce fugitive particulate matter emissions, pursuant to 35 IAC 212.309(a). Any future Fugitive PM Operating Program made by the Permittee during the permit term is automatically incorporated by reference provided the Fugitive PM Operating Program is not expressly disapproved, in writing, by the IEPA within 30 days of receipt of the Fugitive PM Operating Program. In the event that the IEPA notifies the Permittee of a deficiency with any Fugitive PM Operating Program, the Permittee shall be required to revise and resubmit the Fugitive PM Operating Program within 30 days of receipt of notification to address the deficiency pursuant to Section 39.5(7)(a) of the Act.

b. Pursuant to 35 IAC 212.700, the operations at this source are not subject to 35 IAC Part 212 Subpart U because, the operations at the source are not located in the geographical areas defined in 35 IAC 212.324(a)(1).

Should this source become subject to 35 IAC Part 212 Subpart U, then the Permittee shall prepare and operate under a PM_{10} Contingency Measure Plan reflecting the PM_{10} emission reductions as set forth in 35 IAC 212.701 and 212.703. The Permittee shall, within 90 days after the date this source becomes subject to 35 IAC 212.700, submit a request to modify this CAAPP permit in order to include a new, appropriate PM_{10} Contingency Measure Plan.

c. Pursuant to 35 IAC 212.314, Condition 3.1(a)(i)(A) and 35 IAC 212.301 shall not apply when the wind speed is greater than 40.2 km/hr (25 mph).

d. Pursuant to 40 CFR 68.10, the source is not subject to the federal regulations for Chemical Accident Prevention in 40 CFR Part 68 because the source does not meet the listed applicability requirements.

Should this stationary source, as defined in 40 CFR 68.3, become subject to the federal regulations for Chemical Accident Prevention in 40 CFR Part 68, then the Permittee shall submit a compliance schedule for meeting the requirements of 40 CFR Part 68 by the date provided in 40 CFR 68.10(a); or submit a certification statement that the source is in compliance with all requirements of 40 CFR Part 68, including the registration and submission of the Risk Management Plan, as part of the annual compliance certification required by Condition 2.6(a). This condition is imposed in this permit pursuant to 40 CFR 68.215(a)(2)(i) and (ii).

e. i. A. The mobile compression ignition (CI) internal combustion engines (ICE) at ADS Zion Landfill are not subject to the requirements of 40 CFR Part 60 Subpart IIII —Standards of Performance for Stationary Compression Ignition Internal Combustion Engines based upon the engines not meeting the applicability criteria in 40 CFR 60.4200 and the definition of a *stationary internal combustion engine* in 40 CFR 60.4219, i.e., the engines are mobile and meet the definition of a non-road engine as defined in 40 CFR 1068.30.

B. The mobile spark ignition (SI) internal combustion engines (ICE) at ADS Zion Landfill are not subject to the requirements of 40 CFR Part 60 Subpart JJJJ — Standards of Performance for Stationary Spark Ignition Internal Combustion Engines based upon the engines not meeting the applicability criteria in 40 CFR 60.4230 and the definition of a *stationary internal combustion engine* in 40 CFR 60.4248, i.e., the engines are mobile and meet the definition of a non-road engine as defined in 40 CFR 1068.30.

C. The mobile internal combustion engines at ADS Zion Landfill are not subject to the requirements of 40 CFR 63 Subpart ZZZZ — National Emissions Standards for Hazardous Air Pollutants for Stationary Reciprocating Internal Combustion Engines based upon the engines not meeting the applicability criteria in 40 CFR 63.6585(a) and the definition of a *stationary reciprocating internal combustion engine (RICE)* in 40 CFR 63.6675, i.e., the engines are mobile and meet the definition of a non-road engine as defined in 40 CFR 1068.30.

ii. The Permittee shall comply with the following applicable requirements pursuant to Sections 39.5(7)(a), (b), (d), and (e) of the Act.

A. The Permittee shall not have any nonroad engines onsite/in one location at ADS Zion Landfill for more than 12 consecutive months. A location is any single site at a building, structure, facility, or installation. Any engine, or engines, that replaces an engine at a location and that is intended to perform the same or similar function as the engine it replaced will be included in calculating the consecutive time period.

B. i. Pursuant to 35 IAC Part 201.142, the Permittee shall obtain appropriate permits, as applicable, prior the installation of any new stationary engine at the source. Pursuant Section 39.5(14)(b) of the Act, the Permittee shall submit an application to revise this CAAPP permit as a "minor permit modification" subsequent to the installation of any new stationary engine at the source.

ii. Pursuant to 35 IAC 201.142 and Sections 39.5(14)(b) or (c) of the Act, the Permittee either submit the applications and revise this CAAPP permit as per Condition 3.5(e)(ii)(B)(i) or revise this CAAPP as a "significant permit modification" prior to any change in an existing engines applicability to either 40 CFR Part 60 Subpart IIII and/or JJJJ and/or 40 CFR Part 63 Subpart ZZZZ, i.e., any change where an engine would be meet the definition of either a stationary internal combustion engine or stationary RICE.

C. Pursuant to 35 IAC 270.302(b), the Permittee shall submit an application for modification of the CAAPP permit, pursuant to Section 39.5(14) of the Act, within 12 months of a change in an existing engines status, i.e., portable to stationary, or the installation of any new "stationary reciprocating internal combustion engine (RICE)" at the source.

D. Pursuant to Sections 39.5(7)(b) and (e) of the Act, the Permittee shall verify that the engines at the source meet the definition of a mobile and non-road engines, as defined at 40 CFR 1068.30, by collecting and maintaining the following:

I. An annual inventory or list of all engines at the source, with sufficient description to identify each engine (make, model, horsepower, serial number, fuel used, etc.); and

II. Semi-annual record or log of the location of each engine at the source which documents whether the engine is operating at a single location during the past 12 months.

While on site, each engine shall be labeled in such way that it can be determined whether it is a nonroad engine or a stationary engine subject to 40 CFR 63 Subpart ZZZZ.

f. i. The stationary reciprocating internal combustion engines, as defined in 35 IAC 211.6360, at ADS Zion Landfill are not subject to the requirements of 35 IAC Part 217, Subpart Q - Stationary Reciprocating Internal Combustion Engines And Turbines based upon the engines not meeting the applicability criteria in 35 IAC 217.386. Specifically, pursuant to 217.386(a)(2)(A), the engines, located at ADS Zion Landfill, nameplate capacities are less than 500 bhp output.
Note: Applicability and/or non-applicability of the engines located at the adjacent Bio Energy (Illinois) LLC. - Zion Landfill Gas Power Station (ID No. 097200ABC), referenced in Condition 1.3, is addressed separately in CAAPP Permit No. 03070058.

ii. A. Pursuant to Sections 39.5(7)(b) and (e) of the Act, the Permittee shall verify that the engines at the are not applicable to 35 IAC Part 217, Subpart Q, by collecting and maintaining an inventory or list of all engines at the source, with sufficient description to identify each engine (make, model, nameplate capacity/horsepower, serial number, fuel used, etc.).

B. Pursuant to 35 IAC 201.142, the Permittee shall obtain a construction permit prior to the installation of any new "stationary reciprocating internal combustion engine (RICE)" at the source that meets the criteria shown in 35

IAC 201.146(i), i.e., any "combustion engine with a rating at equal to or greater than 500 bhp output that is subject to the control requirements of 35 Ill. Adm. Code 217.388(a) or (b)".

C. Pursuant to 35 IAC 270.302(b), the Permittee shall submit an application for modification of the CAAPP permit, pursuant to Section 39.5(14) of the Act, within 12 months of a change in an existing engines status or the installation of any new "stationary reciprocating internal combustion engine (RICE)" at the source.

6. Reporting Requirements

The Permittee shall submit the following information pursuant to Section 39.5(7)(f) of the Act. Addresses are included in Attachment 2.

a. **Prompt Reporting**

i. A. Pursuant to Section 39.5(7)(f)(ii) of the Act, the Permittee shall promptly notify the IEPA Air Compliance Section within 30 days of deviations from applicable requirements as follows:

I. Requirements in Conditions 3.1(a) through (e).

II. Requirements in Conditions 3.2(a) and (b).

III. Requirements in Condition 3.5(e) and (f).

B. All such deviations shall be summarized and reported as part of the Semiannual Monitoring Report required by Condition 3.6(b).

ii. The Permittee shall notify the IEPA Air Compliance Section, of all other deviations as part of the Semiannual Monitoring Report required by Condition 3.6(b).

iii. The deviation reports shall contain at a minimum the following information:

A. Date and time of the deviation.

B. Emission unit(s) and/or operation involved.

C. The duration of the event.

D. Probable cause of the deviation.

E. Corrective actions or preventative measures taken.

iv. All deviation reports required in this Permit shall be identified, summarized, and reported as part of the Semiannual Monitoring Report required by Condition 3.6(b).

b. **Semiannual Reporting**

i. Pursuant to Section 39.5(7)(f)(i) of the Act, the Permittee shall submit a Semi-Annual Monitoring Report to the Illinois EPA Air Compliance Section summarizing required monitoring and identifying all instances of deviation from the permit, every six months as follows, unless more frequent reporting is required elsewhere in this Permit.

Monitoring Period	Report Due Date
January through June	July 31
July through December	January 31

ii. The Semiannual Monitoring Report must be certified by a Responsible Official consistent with Condition 2.6(b).

c. **Annual Emissions** Reporting

Pursuant to 35 IAC Part 254, the Source shall submit an Annual Emission Report to the Air Quality Planning Section, due by May 1 of the year following the calendar year in which the emissions took place. All records and calculations upon which the verified and reported data are based must be retained by the source.

Section 4 - Emission Unit Requirements

4.1 MSW Landfill

1. Emission Units and Operations

Emission Units	*Pollutants Being Regulated*	*Original Construction Date*	*Modification/ Reconstruction Date*	*Air Pollution Control Devices or Measures*	*Monitoring Devices*
MSW Landfill	Opacity, NO_x, CO, SO_2, PM/PM_{10}, VOM/NMOC, HAPs and Asbestos	Commenced Construction 1975 Initiated Waste Disposal Operations Dec. 31, 1975	May 26, 1998[1] Sept. 1, 2011[2] Oct. 30, 2014[3]	Gas to Energy Facility[3] and 6,000 scfm Enclosed Flare and 3,000 scfm Open Flare[5] Dec. 10, 2008	None

Footnote No.
1 Zion Site #2 expansion was not covered by Construction Permit.
2 Construction Permit 11030009: Approximately 1.7 million cubic yards vertical expansion of landfill.
3 Construction Permit 12070062: Waste capacity increase to approximately 29.2 million cubic yards.
4 The gas to energy facility is owned and operated by Bio Energy (Illinois) LLC (BOA I.D. #097200ABC) and is covered under a separate CAAPP permit, See CAAPP Permit #03070058 for applicable requirements for the gas to energy facility. As per Condition 1.3(a), Bio Energy (Illinois) LLC is considered a single source with ADS Zion Landfill and the gas to energy facility is considered to provide the primary means of landfill gas/NMOC control.
5 Construction Permit 06100001: 3,000 scfm open flare and 6,000 scfm enclosed flare and replaced the previously permitted 2,550 scfm enclosed flare.

It should be noted: Only the requirements applicable to the MSW landfill and its secondary control devices, the enclosed and open flares, are addressed in this Section.

2. Applicable Requirements

For the emission units in Condition 4.1.1 above, the Permittee shall comply with the following applicable requirements pursuant to Sections 39.5(7)(a), 39.5(7)(b), and 39.5(7)(d) of the Act.

a. i. Visible Emissions (Opacity) Requirements

A. Pursuant to 35 IAC 212.123(a), no person shall cause or allow the emission of smoke or other particulate matter, with an opacity greater than 30 percent, except as allowed by 35 IAC 212.123(b) and 212.124.

B. Pursuant to 40 CFR 60.18(c)(1), the open flare shall be designed for and operated with no visible emissions as determined by the methods specified in Condition 4.1.2(a)(ii)(A) and 40 CFR 60.18(f), except for periods not to exceed a total of 5 minutes during any 2 consecutive hours.

ii. **Compliance Method (Opacity Requirements)**

Monitoring

A. I. Pursuant to Sections 39.5(7)(b) and (d) of the Act, the Permittee shall verify proper operation of the enclosed and open flares by conducting monthly inspections of the flares while the flares are in operation to ensure that all combustion components and supporting equipment is functioning properly.

II. Pursuant to Sections 39.5(7)(b), (d) and (e) of the Act, the Permittee shall verify compliance with the limitations in Condition 4.1.2(a)(i)(A) and (B) by performing the following:

(1) Annual visible emission observations of the enclosed and open flares in accordance with Reference Method 22, Appendix A, 40 CFR 60 or the USEPA approved modified Reference Method 22.

(2) If visible emissions in excess of 5 minutes are observed, the Permittee shall take corrective action within 4 hours of such observation. Corrective action may include, but is not limited to, shutdown of the operation, maintenance and repair, and/or adjustment of fuel usage. If corrective action was taken, the Permittee shall perform a follow up observation for visible emissions in accordance with Reference Method 22, Appendix A, 40 CFR 60, or the USEPA approved modified Reference Method 22. If visible emissions continue, then opacity measurements shall be performed within 48 hours of the initial Reference Method 22, Appendix A, 40 CFR 60, or the USEPA approved modified Reference Method 22 using Reference Method 9. Monitoring by a third party is not required unless requested in writing by the IEPA and/or USEPA.

(3) The Permittee shall perform additional monitoring upon Illinois EPA request.

Recordkeeping

B. Pursuant to 39.5(7)(b) and (e) of the Act, the Permittee shall collect and maintain copies of all field data sheets recording observations as Reference Method 22, Appendix A, 40 CFR 60, the USEPA approved modified Reference Method 22 and/or Method 9, which includes, but is not limited to the following:

I. Date and time the observations/measurements were performed;

II. Name(s) of observing personnel and their affiliation;

III. The total elapsed time for each observation, i.e., the observation period, pursuant to the method used;

IV. The results of the observations/measurements including the total amount of time of the presence of any visible emissions;

V. Operational status of the open and enclosed flares being observed;

VI. If applicable, a description of any corrective action taken including if the corrective action took place within 4 hours of the initial observation of exceedance.

C. Pursuant to Section 39.5(7)(b) and (e) of the Act, the Permittee shall maintain records of the monthly open and enclosed flare inspections, including a log of any maintenance and repairs performed on either the enclosed or open flare.

b. i. **Sulfur Dioxide Requirements (SO_2)**

A. Pursuant to 35 IAC 214.301, no person shall cause or allow the emission of sulfur dioxide (SO_2) into the atmosphere from any process emission source to exceed 2000 ppm.

B. Pursuant to Construction Permit 06100001, total emissions of SO_2 from the open and enclosed flares, shall not exceed 45.66 tons/month and 200 tons/year. [T1]

C. I. Pursuant to Construction Permit 11030009, total emissions of SO_2 from the combustion of LFG attributable to the existing ADS Zion landfill, shall not exceed 25.0 tons/month and 200 tons/year. [T1]

II. Pursuant to Construction Permit 11030009, total emissions of SO_2 from the combustion of LFG attributable to the vertical expansion of ADS Zion landfill, covered in Construction Permit 11030009, shall not exceed 4.0 tons/month and 32.0 tons/year. [T1]

D. Pursuant to Construction Permit 12070062, total emissions of SO_2 from the flares (the enclosed flare and open flare), shall not exceed 45.7 lb/hr and 200 tons/year. [T1]

ii. Compliance Method (SO_2 Requirements)

Monitoring

A. Pursuant to Sections 39.5(7)(b), (d) and (f) of the Act and Construction Permit 06100001, 11030009 and 12070062, the Permittee shall demonstrate compliance with Conditions 4.1.2(b)(i)(A) through (D) by the following: [T1]

I. For purposes of determining compliance with the limits in Conditions 4.1.2(b)(i)(A) through (D), emissions shall be determined using site-specific data of the composition of LFG and appropriate emission factors, which in order of preference for pollutants shall be factors from on-site emission testing, manufacturer's emission data, and emission factors from USEPA's Compilation of Air Pollutant Emission Factors (AP-42) with appropriate adjustments to this data and these emission factors to reflect source-specific conditions and any deficiencies in the collection of LFG and operation of units controlling LFG at this affected source.

II. Sampling and analysis for sulfur content of LFG shall be conducted on the following schedule, with the calculations for the sulfur content of collected LFG in pounds per hour made using representative hourly values for the volumes of different streams of collected LFG. If data has been collected previously under earlier permits, it may be used to comply with the requirements below: [T1]

1. Sampling and analysis for sulfur content of LFG collected at this landfill shall be conducted on a quarterly basis, until four required samples in a row indicate the overall sulfur content of the LFG on an hourly basis is no more than 14 pounds (equivalent to SO_2 emissions of 28.0 pounds per hour), at which time sampling and analysis shall be conducted at least annually.

2. Thereafter, if annual sampling indicates the overall sulfur content of the LFG on an hourly basis is more than 18.3 pounds (equivalent to SO_2 emissions of 36.5 pounds per hour) than sampling and analysis on a quarterly basis shall be resumed.

III. LFG Chemical and Physical Composition: The LFG shall be sampled and analyzed for total reduced sulfur (TRS) as per Reference Method 15/16 or ASTM D5504. A written notification of sampling activity and submittal of a formal test protocol for such sampling activity is not required.

For each landfill gas sampling and analysis activity from the active collection system, at least three representative samples of landfill gas shall be collected from the common header pipe before the gas moving or any condensate removal equipment.

IV. Install, calibrate, maintain, and operate according to the manufacturer's specifications a landfill gas flow rate measuring device that shall record the flow to the open and enclosed flares at least every 15 minutes.

V. Compliance with the SO_2 emissions limits in Condition 4.1.2(b)(i)(A) and through (D) shall be verified monthly, using emission factors in developed from representative sampling and analysis of the LFG being generated by this landfill as required by Condition 4.1.2(b)(ii)(B).

Pursuant to Construction Permits 06100001, 11030009, and 12070062, compliance with annual limits shall be determined from a running total of 12 months of data, i.e., the sum of emissions data for the month of record plus the preceding 11 months of data. [T1]

Recordkeeping

B. Pursuant to Sections 39.5(7)(b) and (e) of the Act, the Permittee shall maintain the following records:

I. The LFG consumed by the flares pursuant to Condition 4.1.2(b)(ii)(A)(IV), on a daily, monthly and annual basis.

II. The TRS content of the LFG and the results of the compliance verification procedures pursuant to Condition 4.1.2(b)(ii)(B)(II) with supporting calculations.

III. Log of sampling and analysis activity, including measured data, documentation for the sampling and analysis activities.

IV. Monthly analysis of the representative hourly, monthly and annual emissions of SO_2 from the affected open and enclosed flares (lb/hr, tons/month and tons/year) with supporting documentation and calculations.

C. Pursuant to 39.5(7)(b) and (e) of the Act, the Permittee shall keep an operating and maintenance log(s) which shall include the following:

I. Status of the flare;

II. Adjustments to the flare's operating parameters; and

III. Identification of any period when the flare was to be in service but was out of service with a detailed explanation the cause and an explanation of actions taken to prevent or reduce the likelihood of future occurrences.

c. i. **Nonmethane Organic Compounds Requirements (NMOC)**

A. I. Pursuant to 40 CFR 60.752(b)(2)(i) and Section 39.5(7)(a) of the Act, the landfill gas collection and control system shall be operated as per the Illinois EPA approved collection and control system design plan dated December 4, 2014 and amended November 18, 2016.

1. Pursuant to 40 CFR 60.752(b)(2)(i)(A) and Section 39.5(7)(a) of the Act, the collection and control system shall meet the design requirements in Condition 4.1.2(c)(i)(A)(III) and 40 CFR 60.752(b)(2)(ii).

2. Pursuant to 40 CFR 60.752(b)(2)(i)(B) and Section 39.5(7)(a) of the Act, the following alternatives to the operational standards, test methods, procedures, compliance measures, monitoring, recordkeeping or reporting provisions of 40 CFR 60.753 through 60.758 are approved:

   (a) Pursuant to the USEPA Region 5 determinations, dated April 4, 2008, October 3, 2008, and August 2, 2017 the Permittee may operate extraction points EW01, EW12A, CEW5, and CEW5 and EW-02, REW-1, EW-21, and CEW5WH under the following alternative operational procedures:

      (i) When the oxygen concentration at the extraction location does not decline to acceptable levels after more than one hour of reduced vacuum, the location may be shut off until the gas quality recovers.

      (ii) The monthly monitoring required by 40 CFR Part 60, Subpart WWW will be conducted for these locations, but positive pressure or elevated oxygen concentrations will not be considered as exceedances of the operating limits in 40 CFR 60.753.

      However, the monthly monitoring results must be reported to the Illinois Environmental Protection Agency ("IEPA"). The reports to IEPA shall note if and when the extraction points are shut off in accordance with this alternative procedure.

      (iii) If monthly monitoring indicates that pressure has built up in the extraction point and the oxygen concentration still exceeds 5 percent, the location will be briefly opened to relieve the pressure and may then be shut down until it is monitored the following month.

      (iv) The surface monitoring required by 40 CFR Part 60, Subpart WWW will continue to be conducted in this area. Standard remediation steps, including evaluating the need to return the extraction location to full-time service, must be followed if exceedances of the 500 ppm methane surface concentration limits are detected in the immediate vicinity.

      (v) If the monthly monitoring indicates that gas quality has improved (i.e., the oxygen concentration has dropped below 5 percent), the extraction location will be brought back on line until the gas quality declines again. If the oxygen levels can be maintained below the regulatory limit of 5 percent, this alternate operating procedure is terminated and the well shall be operated in accordance with the regulatory requirements.

(vi) When the collector is not connected to the GCCS, it must be sealed to not allow fugitive landfill gas emissions.

(b) Pursuant to 40 CFR 60.752(b)(2)(i)(D) and 60.759, the Permittee may utilize temporary gas extraction wells, horizontal collection trenches and/or leachate collection systems for LFG extraction, provided that the components are installed as per the approved collection and control system design plan dated December 4, 2014 and amended November 18, 2016 and 40 CFR 60.759, until permanent extraction wells can be installed once the area is at final grade. This exclusion does not shield the temporary LFG extraction points from compliance with the other applicable provisions of 40 CFR Part 60, Subpart WWW.

(c) Pursuant to Condition 4.1.2(c)(ii)(B) and 40 CFR 60.753(d) and 60.756(a), the Permittee may exclude from monitoring:

(i) Those wells installed within the waste boundary and connected to the gas collection and control system (GCCS) for odor control or for purposes other than NMOC control and/or off-site landfill migration control installed prior to the age criteria shown in Condition 4.1.2(c)(i)(B)(I) and 40 CFR 60.753(a); and

(ii) Dangerous areas such as roads, the active area, truck traffic areas, areas with snow or ice covered, and steep sloped areas with grade equals to 4:1 from the surface monitoring plan.

(d) Pursuant to 40 CFR 60.753(b)(2), excluding areas within Phase 1a without a geomembrane or synthetic cover, final cover areas within ADS Zion Landfill with a geomembrane or synthetic cover and sideslope of at least 3:1 and up to 4:1 shall be operated with a maximum positive pressure of 26 inches water column (w.c.) at each gas extraction well. For areas of the landfill with a geomembrane or synthetic cover and sideslope of sideslope of 4:1 or greater, the maximum allowable positive pressure shall not exceed 39 inches w.c.

II. Pursuant to 40 CFR 60.752(b)(2)(ii), the Permittee shall install a collection and control system that captures the gas generated within the landfill as required by the following:

1. Pursuant to 40 CFR 60.752(b)(2)(ii)(A), the active collection system shall:

(a) Pursuant to 40 CFR 60.752(b)(2)(ii)(A)(1), be designed to handle the maximum expected gas flow rate from the entire area of the landfill that warrants control over the intended use period of the gas control or treatment system equipment;

(b) Pursuant to 40 CFR 60.752(b)(2)(ii)(A)(2), collect gas from each area, cell, or group of cells in the landfill in which the initial solid waste has been placed for a period of:

(i) 5 years or more if active; or

(ii) 2 years or more if closed or at final grade.

(c) Pursuant to 40 CFR 60.752(b)(2)(ii)(A)(3), collect gas at a sufficient extraction rate;

(d) Pursuant to 40 CFR 60.752(b)(2)(ii)(A)(4), be designed to minimize off-site migration of subsurface gas.

2. Pursuant to 40 CFR 60.752(b)(2)(iii), the Permittee shall route all the collected gas to a control system that complies with the requirements in 40 CFR 60.752(b)(2)(iii)(A), (B) or (C). The enclosed and open flares at ADS Zion Landfill Inc. shall be designed and operated as follows:

(a) Pursuant to 40 CFR 60.752(b)(2)(iii)(A), the open flare shall be designed and operated in accordance with 40 CFR 60.18:

Where:

(i) Pursuant to 40 CFR 60.18(c)(1), the flare shall be designed for and operated with no visible emissions as determined by the methods specified in 40 CFR 60.18(f), except for periods not to exceed a total of 5 minutes during any 2 consecutive hours.

(ii) Pursuant to 40 CFR 60.18(c)(2), the flare shall be operated with a flame present at all times, as determined by the methods specified in 40 CFR 60.18(f).

(iii) Pursuant to 40 CFR 60.18(c)(3), the Permittee has the choice of adhering to either the heat content specifications in 40 CFR 60.18(c)(3)(ii) and the maximum tip velocity specifications in 40 CFR 60.18(c)(4), or adhering to the requirements in 40 CFR 60.18(c)(3)(i).

(A) Pursuant to 40 CFR 60.18(c)(3)(i)(B), the actual exit velocity of a flare shall be determined by the method specified in 40 CFR 60.18(f)(4).

(B) Pursuant to 40 CFR 60.18(c)(3)(ii), the net heating value of the gas being combusted shall be 7.45 MJ/scm (200 Btu/scf) or greater. The net heating value of the gas being combusted shall be determined by the methods specified in 40 CFR 60.18(f)(3).

(iv) Pursuant to 40 CFR 60.18(c)(4)(i), open flare shall be designed for and operated with an exit velocity, as determined by the methods specified in 40 CFR 60.18(f)(4), less than 18.3 m/sec (60 ft/sec), except as provided in 40 CFR 60.18(c)(4)(ii) and (iii).

(v) Pursuant to 40 CFR 60.18(e), except as provided for in Condition 4.1.2(c)(i)(B)(V) and 40 CFR 60.753(e), flares used to comply with provisions of 40 CFR 60.752 shall be operated at all times when emissions may be vented to them.

(b) (i) Pursuant to 40 CFR 60.752(b)(2)(iii)(B), the enclosed flare shall be designed and operated to either reduce NMOC by 98 weight percent or reduce the outlet NMOC concentration to less than 20 parts per million by volume, dry basis as hexane at 3 percent oxygen. The reduction efficiency or parts per million by volume shall be established by an initial performance test to be completed no later than 180 days after the initial startup of the approved control system using the test methods specified in 40 CFR 60.754(d).

(ii) Pursuant to 40 CFR 60.752(b)(2)(iii)(B)(2), the enclosed flare shall be operated within the parameter ranges established during the most recent performance test. The operating parameters to be monitored are specified in Condition 4.1.2(c)(ii)(B)(II) and 40 CFR 60.756.

III. Pursuant to 40 CFR 60.752(b)(2)(iv), the Permittee shall operate the collection and control device installed to comply with 40 CFR Subpart WWW, in accordance with the provisions Condition 4.1.2(c)(i)(B) and 40 CFR Section 60.753 [Operational standards for collection and control systems]; Conditions 4.1.2(c)(ii)(A)(II) through (VI) and 40 CFR Section 60.755 [Compliance provisions]; and Condition 4.1.2(c)(ii)(B) and 40 CFR Section 60.756 [Monitoring of operations].

IV. Pursuant to 40 CFR 60.752(b)(2)(v), the collection and control system may be capped or removed provided that all the conditions of 40 CFR 60.752(b)(2)(v)(A), (B), and (C) are met:

1. The landfill shall be a closed landfill as defined in 40 CFR 60.751. A closure report shall be submitted to the Illinois EPA Compliance Section as provided in Condition 4.5(b)(i)(B) and 40 CFR 60.757(d);

2. The collection and control system shall have been in operation a minimum of 15 years; and

3. Following the procedures specified in Condition 4.1.2(c)(ii)(C)(I) and 40 CFR 60.754(b), the calculated NMOC gas produced by the landfill shall be less than 50 megagrams per year on three successive test dates. The test dates shall be no less than 90 days apart, and no more than 180 days apart.

B. I. Pursuant to 40 CFR 60.753(a), the Permittee shall operate the collection system such that gas is collected from each area, cell, or group of cells in the MSW landfill in which solid waste has been in place for:

1. 5 years or more if active; or

2. 2 years or more if closed or at final grade;

II. Pursuant to 40 CFR 60.753(b), the Permittee shall operate the collection system with negative pressure at each wellhead except under the following conditions:

1. A fire or increased well temperature;

2. Use of a geomembrane or synthetic cover. The Permittee shall develop acceptable pressure limits in the design plan. ~ Note: Approved pressure limits are shown in Condition 4.1.2(c)(i)(A)(I)(2)(d);

3. A decommissioned well. A well may experience a static positive pressure after shut down to accommodate for declining flows. All design changes shall be approved by the Illinois EPA.

III. Pursuant to 40 CFR 60.753(c), the Permittee shall operate each interior wellhead in the collection system with a landfill gas temperature less than 55°C (131°F) and with either a nitrogen level less than 20 percent or an oxygen level less than 5 percent. The Permittee may establish a higher operating temperature, nitrogen, or oxygen value at a particular well. A higher operating value demonstration shall show supporting data that the elevated parameter does not cause fires or significantly inhibit anaerobic decomposition by killing methanogens.

IV. Pursuant to 40 CFR 60.753(d), the Permittee shall operate the collection system so that the methane concentration is less than 500 ppm above background at the surface of the landfill.

V. Pursuant to 40 CFR 60.753(e), the Permittee shall operate the system such that all collected gases are vented to a control system designed and operated in compliance with Condition 4.1.2(c)(i)(A)(II)(2) and 40 CFR 60.752(b)(2)(iii). In the event the collection or control system is inoperable, the gas mover system shall be shut down and all valves in the collection and control system contributing to venting of the gas to the atmosphere shall be closed within 1 hour.

VI. Pursuant to 40 CFR 60.753(f), the Permittee shall operate the control system at all times when the collected gas is routed to the system.

VII. Pursuant to 40 CFR 60.753(g), if monitoring demonstrates that the operational requirements in Condition 4.1.2(c)(i)(B)(II), (III), or (IV) and 40 CFR 60.753(b), (c), or (d) are not met, corrective action shall be taken as specified in Condition 4.1.2(c)(ii)(A)(II)(3) through (5) and/or 4.1.2(c)(ii)(A)(IV) and 40 CFR 60.755(a)(3) through (5) and/or 40 CFR 60.755(c). If corrective actions are taken as specified in Condition 4.1.2(c)(ii)(A)(II) and 40 CFR 60.755, the monitored exceedance is not a violation of the operational requirements in Condition 4.1.2(c)(i)(B) and 40 CFR 60.753.

C. I. Pursuant to 40 CFR 60.759(a), the Permittee shall site active collection wells, horizontal collectors, surface collectors, or other extraction devices at a sufficient density throughout all gas producing areas using the following procedures unless alternative procedures have been approved in the collection and control system design plan as provided in 40 CFR 60.752(b)(2)(i)(C) and (D):

1. Pursuant to 40 CFR 60.759(a)(1), the collection devices within the interior and along the perimeter areas shall be certified to achieve comprehensive control of surface gas emissions by a professional engineer. The following issues shall be addressed

in the design: depths of refuse, refuse gas generation rates and flow characteristics, cover properties, gas system expandability, leachate and condensate management, accessibility, compatibility with filling operations, integration with closure end use, air intrusion control, corrosion resistance, fill settlement, and resistance to the refuse decomposition heat.

2. Pursuant to 40 CFR 60.759(a)(2), the sufficient density of gas collection devices determined in Condition 4.1.2(c)(i)(C)(I)(1) and 40 CFR 60.759(a)(1) shall address landfill gas migration issues and augmentation of the collection system through the use of active or passive systems at the landfill perimeter or exterior.

3. Pursuant to 40 CFR 60.759(a)(3), the placement of gas collection devices determined in Condition 4.1.2(c)(i)(C)(1) and 40 CFR 60.759(a)(1) shall control all gas producing areas, except as provided as follows:

(a) Pursuant to 40 CFR 60.759(a)(3)(i), any segregated area of asbestos or nondegradable material may be excluded from collection if documented as provided in Condition 4.1.2(c)(ii)(D)(VII)(2) and 40 CFR 60.758(d). The documentation shall provide the nature, date of deposition, location and amount of asbestos or nondegradable material deposited in the area, and shall be provided to the Illinois EPA upon request.

(b) Pursuant to 40 CFR 60.759(a)(3)(ii), any nonproductive area of the landfill may be excluded from control, provided that the total of all excluded areas can be shown to contribute less than 1 percent of the total amount of NMOC emissions from the landfill. The amount, location, and age of the material shall be documented and provided to the Illinois EPA upon request. A separate NMOC emissions estimate shall be made for each section proposed for exclusion, and the sum of all such sections shall be compared to the NMOC emissions estimate for the entire landfill. Emissions from each section shall be computed using the equation in 40 CFR 40 CFR 60.759(a)(3)(ii).

(c) Pursuant to 40 CFR 60.759(a)(3)(iii), the values for k and CNMOC determined in field testing shall be used if field testing has been performed in determining the NMOC emission rate or the radii of influence (this distance from the well center to a point in the landfill where the pressure gradient applied by the blower or compressor approaches zero). If field testing has not been performed, the default values for k, LO and CNMOC provided in 40 CFR 60.754(a)(1) or the alternative values from 40 CFR 60.754(a)(5) shall be used. The mass of nondegradable solid waste contained within the given section may be subtracted from the total mass of the section when estimating emissions provided the nature, location, age, and amount of the nondegradable material is documented as provided in Condition 4.1.2(c)(i)(C)(I)(3)(a) and 40 CFR 60.759(a)(3)(i).

II. Pursuant to 40 CFR 60.759(b), the Permittee shall construct the gas collection devices using the following equipment or procedures:

1. The landfill gas extraction components shall be constructed of polyvinyl chloride (PVC), high density polyethylene (HDPE) pipe, fiberglass, stainless steel, or other nonporous corrosion resistant material of suitable dimensions to: convey projected amounts of gases; withstand installation, static, and settlement forces; and withstand planned overburden or traffic loads. The collection system shall extend as necessary to comply with emission and migration standards. Collection devices such as wells and horizontal collectors shall be perforated to allow gas entry without head loss sufficient to impair performance across the intended extent of control. Perforations shall be situated with regard to the need to prevent excessive air infiltration.

2. Vertical wells shall be placed so as not to endanger underlying liners and shall address the occurrence of water within the landfill. Holes and trenches constructed for piped wells and horizontal collectors shall be of sufficient cross-section so as to allow for their proper construction and completion including, for example, centering of pipes and placement of gravel backfill. Collection devices shall be designed so as not to allow indirect short circuiting of air into the cover or refuse into the collection system or gas into the air. Any gravel used around pipe perforations should be of a dimension so as not to penetrate or block perforations.

3. Collection devices may be connected to the collection header pipes below or above the landfill surface. The connector assembly shall include a positive closing throttle valve, any necessary seals and couplings, access couplings and at least one sampling port. The collection devices shall be constructed of PVC, HDPE, fiberglass, stainless steel, or other nonporous material of suitable thickness.

III. Pursuant to 40 CFR 60.759(c), the Permittee shall convey the landfill gas to a control system in compliance with 4.1.2(c)(i)(A)(II)(2) and 40 CFR 60.752(b)(2)(iii) through the collection header pipe(s). The gas mover equipment shall be sized to handle the maximum gas generation flow rate expected over the intended use period of the gas moving equipment using the following procedures:

1. Pursuant to 40 CFR 60.759(c)(1), for existing collection systems, the flow data shall be used to project the maximum flow rate. If no flow data exists, the procedures below in Condition 4.1.2(c)(i)(C)(III)(2) and 40 CFR 60.759(c)(2) shall be used.

2. Pursuant to 40 CFR 60.759(c)(2), for new collection systems, the maximum flow rate shall be in accordance with Condition 4.1.2(c)(ii)(A)(II)(1) and 40 CFR 60.755(a)(1).

D. Pursuant to 40 CFR 60.1(a), the Permittee must comply with the applicable General Provisions in 40 CFR 60.1 through 60.19 (See Section 7.3(a) of this permit.).

ii. **Compliance Method (NMOC Requirements)**

Compliance Provisions

A. I. 1. Pursuant to Section 39.5(7)(b) of the Act, the Permittee shall operate the GCCS under the provisions of the GCCS design plan prepared by the Permittee and submitted to the IEPA for its review as required in Conditions 4.1.2(c)(i)(A)(I) and 40 CFR 60.752(b)(2)(i). The GCCS design plan shall be designed to significantly capture the gas generated within the MSW landfill and reduce NMOC emissions, pursuant to Section 39.5(7)(a) of the Act and Conditions 4.1.2(c)(i)(A)(II)-(III) and 40 CFR 60.752(b)(2)(ii) and (iv). The Permittee shall comply with the GCCS design plan and any amendments to the GCCS design plan submitted pursuant to Conditions 4.1.2(c)(i)(A)(I)(2).

2. Pursuant to Section 39.5(7)(a) of the Act and Condition 4.1.2(c)(i)(A)(I), the GCCS design plan shall be amended from time to time by the Permittee so that the GCCS design plan is current. Such amendments shall be consistent with the requirements set forth Conditions 4.1.2(c)(i)(A)(II)-(III) and 40 CFR 60.752(b)(2)(ii) and (iv) and shall be submitted to the IEPA within 30 days of such amendment. Any future revision to the GCCS design plan made by the Permittee during the permit term is automatically incorporated by reference provided the revision is not expressly disapproved, in writing, by the IEPA within 30 days of receipt of the revision. In the event that the IEPA notifies the Permittee of a deficiency with any revision to the GCCS design plan, the Permittee shall be required to revise and resubmit the GCCS design plan within 30 days of receipt of notification to address the deficiency pursuant to Section 39.5(7)(a) of the Act.

3. The GCCS design plan, dated December 4, 2014 and amended November 18, 2016, is incorporated herein by reference. The document constitutes the formal established GCCS design plan required by Condition 4.1.2(c)(i)(A)(I) and 40 CFR 60.752(b)(2)(i), addressing the capture of the gas generated within the MSW landfill and reduce NMOC emissions.

II. Pursuant to 40 CFR 60.755(a), except as provided, if applicable, in Condition 4.1.2(c)(i)(A)(I)(2) and 40 CFR 60.752(b)(2)(i)(B), the specified methods below and in 40 CFR 60.755(a)(1) through (a)(6) shall be used to determine whether the gas collection system is in compliance with Condition 4.1.2(c)(i)(A)(II) and 40 CFR 60.752(b)(2)(ii).

1. Pursuant to 40 CFR 60.755(a)(1), for the purposes of calculating the maximum expected gas generation flow rate from the landfill to determine compliance with Condition 4.1.2(c)(i)(A)(II)(1)(a) and 40 CFR 60.752(b)(2)(ii)(A)(1), one of the equations in 40 CFR 60.755(a)(1)(i) or (ii) shall be used. The k and Lo kinetic factors should be those published in the most recent Compilation of Air Pollutant Emission Factors (AP-42) or other site specific values demonstrated to be appropriate and approved by the Illinois EPA Compliance Section or USEPA. If k has been determined as specified in 40 CFR 60.754(a)(4), the value of k determined from the test shall be used. A value of no more than 15 years shall be used for the intended use period of the gas mover equipment. The active life of the landfill is the age of the landfill plus the estimated number of years until closure.

Pursuant to 40 CFR 60.755(a)(1)(iii), actual flow data may be used to project the maximum expected gas generation flow rate instead of, or in conjunction with, the equations in 40 CFR 60.755(a)(1)(a)(1)(i) and (ii). If the landfill is still accepting waste, the actual measured flow data will not equal the maximum expected gas generation rate, so calculations using the equations in 40 CFR 60.755(a)(1)(a)(1)(i) or (ii) or other methods shall be used to predict the maximum expected gas generation rate over the intended period of use of the gas control system equipment.

2. Pursuant to 40 CFR 60.755(a)(2), for the purposes of determining sufficient density of gas collectors for compliance with Condition 4.1.2(c)(i)(A)(II)(1)(b) and 40 CFR 60.752(b)(2)(ii)(A)(2), the Permittee shall design a system of vertical wells, horizontal collectors, or other collection devices, satisfactory to the Illinois EPA, capable of controlling and extracting gas from all portions of the landfill sufficient to meet all operational and performance standards.

3. Pursuant to 40 CFR 60.755(a)(3), for the purpose of demonstrating whether the gas collection system flow rate is sufficient to determine compliance with Condition 4.1.2(c)(i)(A)(II)(1)(c) and 40 CFR 60.752(b)(2)(ii)(A)(3), the Permittee shall measure gauge pressure in the gas collection header at each individual well, monthly. If a positive pressure exists, action shall be initiated to correct the exceedance within 5 calendar days, except for the three conditions allowed under Condition 4.1.2(c)(i)(B)(II) and 40 CFR 60.753(b). If negative pressure cannot be achieved without excess air infiltration within 15 calendar days of the first measurement, the gas collection system shall be expanded to correct the exceedance within 120 days of the initial measurement of positive pressure. Any attempted corrective measure shall not cause exceedances of other operational or performance standards. An alternative timeline for correcting the exceedance may be submitted to the Administrator for approval.

4. Pursuant to 40 CFR 60.755(a)(5), for the purpose of identifying whether excess air infiltration into the landfill is occurring, the Permittee shall monitor each well monthly for temperature and nitrogen or oxygen as provided in Condition 4.1.2(c)(i)(B)(III) and 40 CFR 60.753(c). If a well exceeds one of these operating parameters, action shall be initiated to correct the exceedance within 5 calendar days. If correction of the exceedance cannot be achieved within 15 calendar days of the first measurement, the gas collection system shall be expanded to correct the exceedance within 120 days of the initial exceedance. Any attempted corrective measure shall not cause exceedances of other operational or performance standards. An alternative timeline for correcting the exceedance may be submitted to the Administrator for approval.

5. Pursuant to 40 CFR 60.755(a)(6), if the Permittee seeks to demonstrate compliance with Condition 4.1.2(c)(i)(A)(II)(1)(d) and 40 CFR 60.752(b)(2)(ii)(A)(4) through the use of a collection system not conforming to the specifications provided in Condition 4.1.2(c)(i)(C) and 40 CFR 60.759, the Permittee shall provide information satisfactory to the Illinois EPA Compliance Section as specified in 40 CFR 60.752(b)(2)(i)(C) demonstrating that off-site migration is being controlled.

III. Pursuant to 40 CFR 60.755(b), for purposes of compliance with 40 60.753(a), the Permittee shall place each well or design component as specified in the approved design plan as provided in Condition

4.1.2(c)(i)(A)(I) and 40 CFR 60.752(b)(2)(i). Each well shall be installed no later than 60 days after the date on which the initial solid waste has been in place for a period of:

1. 5 years or more if active; or

2. 2 years or more if closed or at final grade.

IV. Pursuant to 40 CFR 60.755(c), the following procedures shall be used for compliance with the surface methane operational standard as provided in Condition 4.1.2(c)(i)(B)(IV) and 40 CFR 60.753(d).

1. Pursuant to 40 CFR 60.755(c)(1), the Permittee shall monitor surface concentrations of methane along the entire perimeter of the collection area and along a pattern that traverses the landfill at 30 meter intervals (or a site-specific established spacing) for each collection area on a quarterly basis using an organic vapor analyzer, flame ionization detector, or other portable monitor meeting the specifications provided in Condition 4.1.2(c)(ii)(A)(V) and 40 CFR 60.755(d).

2. Pursuant to 40 CFR 60.755(c)(2), the background concentration shall be determined by moving the probe inlet upwind and downwind outside the boundary of the landfill at a distance of at least 30 meters from the perimeter wells.

3. Pursuant to 40 CFR 60.755(c)(3), surface emission monitoring shall be performed in accordance with RM 21 of Appendix A of 40 CFR Part 60, except that the probe inlet shall be placed within 5 to 10 centimeters of the ground. Monitoring shall be performed during typical meteorological conditions.

4. Pursuant to 40 CFR 60.755(c)(4), any reading of 500 parts per million or more above background at any location shall be recorded as a monitored exceedance and the actions specified below and in 40 CFR 60.755(c)(4)(i) through (v) shall be taken. As long as the specified actions are taken, the exceedance is not a violation of the operational requirements of Condition 4.1.2(c)(i)(B)(IV) and 40 CFR 60.753(d).

   (a) Pursuant to 40 CFR 60.755(c)(4)(i), the location of each monitored exceedance shall be marked and the location recorded.

   (b) Pursuant to 40 CFR 60.755(c)(4)(ii), cover maintenance or adjustments to the vacuum of the adjacent wells to increase the gas collection in the vicinity of each exceedance shall be made and the location shall be re-monitored within 10 calendar days of detecting the exceedance.

   (c) Pursuant to 40 CFR 60.755(c)(4)(iii), if the re-monitoring of the location shows a second exceedance, additional corrective action shall be taken and the location shall be monitored again within 10 days of the second exceedance. If the re-monitoring shows a third exceedance for the same location, the action specified in Condition 4.1.2(c)(ii)(A)(IV)(4)(e) and 40 CFR 60.755(c)(4)(v) shall be taken, and no further monitoring of that location is required until the action specified in Condition 4.1.2(c)(ii)(A)(IV)(4)(e) and 40 CFR 60.755(c)(4)(v).

(d) Pursuant to 40 CFR 60.755(c)(4)(iv), any location that initially showed an exceedance but has a methane concentration less than 500 ppm methane above background at the 10-day re-monitoring specified in Conditions 4.1.2(c)(ii)(A)(IV)(4)(b) or (c) and 40 CFR 60.755(c)(4)(ii) or (iii) shall be re-monitored 1 month from the initial exceedance. If the 1-month re-monitoring shows a concentration less than 500 parts per million above background, no further monitoring of that location is required until the next quarterly monitoring period. If the 1-month re-monitoring shows an exceedance, the actions specified in Conditions 4.1.2(c)(ii)(A)(IV)(4)(c) or (e) and 40 CFR 60.755(c)(4)(iii) or (v) shall be taken.

(e) Pursuant to 40 CFR 60.755(c)(4)(v), for any location where monitored methane concentration equals or exceeds 500 parts per million above background three times within a quarterly period, a new well or other collection device shall be installed within 120 calendar days of the initial exceedance. An alternative remedy to the exceedance, such as upgrading the blower, header pipes or control device, and a corresponding timeline for installation may be submitted to the Administrator for approval.

(f) Pursuant to 40 CFR 60.753(d), to determine if this level is exceeded, the Permittee shall conduct surface testing around the perimeter of the collection area and along a pattern that traverses the landfill at 30 meter intervals and where visual observations indicate elevated concentrations of landfill gas, such as distressed vegetation and cracks or seeps in the cover. The Permittee may establish an alternative traversing pattern that ensures equivalent coverage. A surface monitoring design plan shall be developed that includes a topographical map with the monitoring route and the rationale for any site-specific deviations from the 30 meter intervals. Areas with steep slopes or other dangerous areas may be excluded from the surface testing.

5. Pursuant to 40 CFR 60.755(c)(5), the Permittee shall implement a program to monitor for cover integrity and implement cover repairs as necessary on a monthly basis.

V. Pursuant to 40 CFR 60.755(d), the Permittee shall comply with the following instrumentation specifications and procedures for surface emission monitoring devices:

1. The portable analyzer shall meet the instrument specifications provided in RM 21 of Appendix A of 40 CFR Part 60, except that "methane" shall replace all references to VOC.

2. The calibration gas shall be methane, diluted to a nominal concentration of 500 parts per million in air.

3. To meet the performance evaluation requirements in RM 21, the instrument evaluation procedures of RM 21 shall be used.

4. The calibration procedures provided in RM 21 shall be followed immediately before commencing a surface monitoring survey.

VI. Pursuant to 40 CFR 60.755(e), the provisions of 40 CFR 60 Subpart WWW shall apply at all times, except during periods of start-up, shutdown, or malfunction, provided that the duration of start-up, shutdown, or malfunction shall not exceed 5 days for collection systems and shall not exceed 1 hour for treatment or control devices.

Monitoring

B. I. Pursuant to 40 CFR 60.756(a), the Permittee shall install a sampling port and a thermometer, other temperature measuring device, or an access port for temperature measurements at each wellhead and:

1. Measure the gauge pressure in the gas collection header on a monthly basis as provided in Condition 4.1.2(c)(ii)(A)(II)(3) and 40 CFR 60.755(a)(3); and

2. Monitor nitrogen or oxygen concentration in the landfill gas on a monthly basis as provided in Condition 4.1.2(c)(ii)(A)(II)(4) and 40 CFR 60.755(a)(5); and

Pursuant to Condition 4.1.2(c)(i)(B)(III) and 40 CFR 40 CFR 60.753(c),

(a) The nitrogen level shall be determined using Method 3C, unless an alternative test method is established in the collection and control system design plan as allowed, if applicable, in Conditions 4.1.2(c)(i)(A)(I) and 40 CFR 60.752(b)(2)(i).

(b) Unless an alternative test method is established in the collection and control system design plan as allowed, if applicable, in Condition 4.1.2(c)(i)(A)(I) and 40 CFR 60.752(b)(2)(i), the oxygen shall be determined by an oxygen meter using Method 3A or 3C except that:

(i) The span shall be set so that the regulatory limit is between 20 and 50 percent of the span;

(ii) A data recorder is not required;

(iii) Only two calibration gases are required, a zero and span, and ambient air may be used as the span;

(iv) A calibration error check is not required;

v. The allowable sample bias, zero drift, and calibration drift are ±10 percent.

3. Monitor temperature of the landfill gas on a monthly basis as provided in Condition 4.1.2(c)(ii)(A)(II)(4) and 40 CFR 60.755(a)(5).

II. Pursuant to 40 CFR 60.756(b), the Permittee shall monitor temperature and flow or bypasses of the enclosed flare. This monitoring equipment shall be calibrated, maintained, and operated according to the manufacturer's specifications, as follows:

1. Pursuant to 40 CFR 60.756(b)(1), a temperature monitoring device equipped with a continuous recorder and having a minimum accuracy of ±1 percent of the temperature being measured expressed in degrees Celsius or ±0.5 degrees Celsius, whichever is greater.

2. Pursuant to 40 CFR 60.756(b)(2), a device that records flow to or bypass of the enclosed flare. The Permittee shall either:

   (a) Install, calibrate, and maintain a gas flow rate measuring device that shall record the flow to the control device at least every 15 minutes; or

   (b) Secure the bypass line valve in the closed position with a car-seal or a lock-and-key type configuration. A visual inspection of the seal or closure mechanism shall be performed at least once every month to ensure that the valve is maintained in the closed position and that the gas flow is not diverted through the bypass line.

III. Pursuant to 40 CFR 60.756(c) and 40 CFR 60.18(f)(2), the Permittee shall install, calibrate, maintain, and operate according to the manufacturer's specifications the following equipment on the open flare:

1. A heat sensing device, such as an ultraviolet beam sensor or thermocouple, at the pilot light or the flame itself to indicate the continuous presence of a flame.

2. A device that records flow to or bypass of the flare. The Permittee shall either:

   (a) Install, calibrate, and maintain a gas flow rate measuring device that shall record the flow to the control device at least every 15 minutes; or

   (b) Secure the bypass line valve in the closed position with a car-seal or a lock-and-key type configuration. A visual inspection of the seal or closure mechanism shall be performed at least once every month to ensure that the valve is maintained in the closed position and that the gas flow is not diverted through the bypass line.

IV. Pursuant to 40 CFR 60.756(f), the Permittee shall monitor surface concentrations of methane according to the instrument specifications and procedures provided in Condition 4.1.2(c)(ii)(A)(V) and 40 CFR 60.755(d). Any closed landfill that has no monitored exceedances of the operational standard in three consecutive quarterly monitoring periods may skip to annual monitoring. Any methane reading of 500 ppm or more above background detected during the annual monitoring returns the frequency for that landfill to quarterly monitoring.

V. Pursuant to 39.5(7)(b) and (d) of the Act, the Permittee shall verify compliance of the open flare with the minimum "7.45 MJ/scm (200 Btu/scf) LFG net heat content limitation in Condition 4.1.2(c)(i)(A)(II)(2)(a)(iii)(B) and 40 CFR 60.18(c)(ii) annually, the net heating value of the combusted landfill gas as determined in 40 CFR 60.18(f)(3) shall be calculated from the concentration of methane in the landfill gas as measured by Method 3C of Appendix A of 40 CFR Part 60. A minimum of three 30-minute Method 3C samples shall be used to make the determination. The measurement of other organic components, hydrogen, and carbon monoxide is not applicable. Method 3C may be used to determine the landfill gas molecular weight for calculating the flare gas exit velocity under 40 CFR 60.18(f)(4). A written notification of sampling/monitoring activity and submittal of a formal test protocol for such sampling/monitoring activity is not required.

VI. Pursuant to 39.5(7)(b) and (d) of the Act, the Permittee shall verify compliance of the enclosed flare with the NMOC 98 weight-percent control efficiency or the 20 ppmv outlet concentration level, in Condition 4.1.2(c)(i)(A)(II)(2)(b) and 40 CFR 60.752(b)(2)(iii)(B) by performing a subsequent performance test and submitting a performance test report as part of the CAAPP permit renewal application. The performance test shall be performed no more than two years prior to the expiration date of this CAAPP permit. Pursuant to 40 CFR 60.754(d), Method 25, 25C, or Method 18 of Appendix A of 40 CFR Part 60 must be used to determine compliance with the 98 weight-percent efficiency or the 20 ppmv outlet concentration level, unless another method to demonstrate compliance has been approved by the Administrator as provided by 40 CFR 60.752(b)(2)(i)(B). Method 3 or 3A shall be used to determine oxygen for correcting the NMOC concentration as hexane to 3 percent. In cases where the outlet concentration is less than 50 ppm NMOC as carbon (8 ppm NMOC as hexane), Method 25A should be used in place of Method 25. If using Method 18 of Appendix A of this part, the minimum list of compounds to be tested shall be those published in the most recent Compilation of Air Pollutant Emission Factors (AP-42). The following equation shall be used to calculate efficiency:

$$\text{Control Efficiency} = (NMOC_{in} - NMOC_{out}) / (NMOC_{in})$$

where,

$NMOC_{in}$ = mass of NMOC entering control device

$NMOC_{out}$ = mass of NMOC exiting control device

Written notification of sampling activity and submittal of a formal test protocol for such sampling activity is required as per Conditions 2.4 and 7.1 of this permit.

Testing

C. I. Pursuant to 40 CFR 60.754(b), the Permittee shall calculate the NMOC emission rate for purposes of determining when the system can be removed as provided in Condition 4.1.2(c)(i)(A)(IV) and 40 CFR 60.752(b)(2)(v), using the equation in 40 CFR 60.754(b).

1. Pursuant to 40 CFR 60.754(b)(1), the flow rate of landfill gas, QLFG, shall be determined by measuring the total landfill gas flow rate at the common header pipe that leads to the control device using a gas flow measuring device calibrated according to the provisions of Section 4 of Method 2E of Appendix A of 40 CFR Part 60.

2. Pursuant to 40 CFR 60.754(b)(2), the average NMOC concentration, CNMOC, shall be determined by collecting and analyzing landfill gas sampled from the common header pipe before the gas moving or condensate removal equipment using the procedures in Method 25C or Method 18 of Appendix A of 40 CFR Part 60. If using Method 18 of Appendix A of 40 CFR Part 60, the minimum list of compounds to be tested shall be those published in the most recent Compilation of Air Pollutant

Emission Factors (AP-42). The sample location on the common header pipe shall be before any condensate removal or other gas refining units. The Permittee shall divide the NMOC concentration from Method 25C of Appendix A of 40 CFR Part 60 by six to convert from CNMOC as carbon to CNMOC as hexane.

3. Pursuant to 40 CFR 60.754(b)(3), the Permittee may use another method to determine landfill gas flow rate and NMOC concentration if the method has been approved by the USEPA.

II. Pursuant to 40 CFR 60.754(c), when calculating emissions for PSD purposes, the Permittee shall estimate the NMOC emission rate for comparison to the PSD major source and significance levels in 40 CFR 51.166 or 52.21 using AP-42 or other approved measurement procedures.

Recordkeeping

General Records

D. I. Pursuant to Sections 39.5(7)(b) and (e) of the Act, the Permittee shall keep readily accessible, on-site records of the items listed below. Off-site records may be maintained if they are retrievable within 4 hours. Either paper copy or electronic formats are acceptable.

1. Site-specific NMOC emission rate(s) and/or methane generation rate constant(s) (k) used to determine MSW landfill emissions (megagrams/yr) allowed under 40 CFR 60.754(a)(3), (4), and/or (5).

2. Copies of USEPA and/or Illinois EPA correspondence approving alternatives to the operational standards, test methods, procedures, compliance measures, monitoring, recordkeeping or reporting provisions of 40 CFR 60.753 through 60.758 allowed under, if applicable, in Condition 4.1.2(c)(i)(A)(I)(2) and 40 CFR 60.752(b)(2)(i)(B).

3. Waste Acceptance

Copies of all waste acceptance records required to be maintained under 35 IAC Subtitle G (i.e., daily, monthly, and/or quarterly solid waste records and summaries). At a minimum these records shall include:

a. Monthly records of the amount of waste accepted;

b. The year-by-year waste acceptance rate;

c. The total amount of waste in-place; and

4. An inspection maintenance and repair log for the affected landfill and/or control equipment, listing each activity performed with date. This requirement includes the landfill cover integrity inspection and repair requirement in Condition 4.1.2(c)(ii)(A)(IV)(5) and 40 CFR 60.755(c)(5).

5. Up-to-date, readily accessible continuous records of the landfill flow to the control system (Monthly and annual). Annual landfill gas usage shall be determined on a calendar year basis.

6. Operating hours on a monthly basis for each flare.

NSPS Records

II. Pursuant to 40 CFR Section 60.7(b); the owners or operators shall maintain records of the occurrence and duration of any startup, shutdown, or malfunction in the operation of the GCCS including; any malfunction of the air pollution control equipment; or any periods during which a continuous monitoring system or monitoring device is inoperative.

III. Pursuant to 40 CFR Section 60.7(f); the owners or operators shall maintain a file of all measurements, maintenance, reports and records.

IV. Pursuant to 40 CFR 60.758(a), except as provided, if applicable, in Condition 4.1.2(c)(i)(A)(I)(2) and 40 CFR 60.752(b)(2)(i)(B), the Permittee shall keep up-to-date, readily accessible, on-site records of the design capacity report which triggered 40 CFR 60.752(b), the current amount of solid waste in-place, and the year-by-year waste acceptance rate. Off-site records may be maintained if they are retrievable within 4 hours. Either paper copy or electronic formats are acceptable.

V. Pursuant to 40 CFR 60.758(b), except as provided, if applicable, in Condition 4.1.2(c)(i)(A)(I)(2) and 40 CFR 60.752(b)(2)(i)(B), the Permittee shall keep up-to-date, readily accessible records for the life of the control equipment of the data listed in below as measured during the initial performance test or compliance determination. Records of subsequent tests or monitoring shall be maintained for a minimum of 5 years. Records of the open and enclosed flare vendor specifications shall be maintained until removal.

1. Pursuant to 40 CFR 60.758(b)(1)(i), the maximum expected gas generation flow rate as calculated in Condition 4.1.2(c)(ii)(A)(II)(1) and 40 CFR 60.755(a)(1). The Permittee may use another method to determine the maximum gas generation flow rate, if the method has been approved by the Illinois EPA Compliance Section or USEPA.

2. Pursuant to 40 CFR 60.758(b)(1)(ii), the density of wells, horizontal collectors, surface collectors, or other gas extraction devices determined using the procedures specified in Condition 4.1.2(c)(i)(C)(I)(1) and 40 CFR 60.759(a)(1).

3. (a) Pursuant to 40 CFR 60.758(b)(2)(i), the average combustion temperature of the enclosed flare, measured at least every 15 minutes and averaged over the same time period of the performance test.

   (b) Pursuant to 40 CFR 60.758(b)(2)(i), the enclosed flare percent reduction of NMOC determined as specified in Condition 4.1.2(c)(i)(A)(II)(2)(b) and 40 CFR 60.752(b)(2)(iii)(B) achieved by the control device.

VI. Pursuant to 40 CFR 60.758(c), the Permittee shall keep up-to-date, readily accessible continuous records of the equipment operating parameters specified to be monitored in Condition 4.1.2(c)(ii)(B) and 40 CF 60.756 as well as up-to-date, readily accessible records for periods of operation during which the parameter boundaries established during the most recent performance test are exceeded.

1. Pursuant to 40 CFR 60.758(c)(1)(i), the following constitutes exceedances that shall be recorded: All 3-hour periods of operation during which the average combustion temperature was more than 28 °C below the average combustion temperature during the most recent performance test at which compliance with §60.752(b)(2)(iii) was determined.

2. Pursuant to 40 CFR 60.758(c)(2), the Permittee shall keep up-to-date, readily accessible continuous records of the indication of flow to the control device or the indication of bypass flow or records of monthly inspections of car-seals or lock-and-key configurations used to seal bypass lines, specified in Condition 4.1.2(c)(ii)(B)(II) and 40 CFR 60.756.

VII. Pursuant to 40 CFR 60.758(d), except as provided in Condition 4.1.2(c)(i)(A)(I) and 40 CFR 60.752(b)(2)(i)(B), the Permittee shall keep for the life of the collection system an up-to-date, readily accessible plot map showing each existing and planned collector in the system and providing a unique identification location label for each collector.

1. Pursuant to 40 CFR 60.758(d)(1), the shall keep up-to-date, readily accessible records of the installation date and location of all newly installed collectors as specified under 40 CFR 60.755(b).

2. Pursuant to 40 CFR 60.758(d)(2), the Permittee shall keep readily accessible documentation of the nature, date of deposition, amount, and location of asbestos-containing or nondegradable waste excluded from collection as provided in 40 CFR 60.759(a)(3)(i) as well as any nonproductive areas excluded from collection as provided in 40 CFR 60.759(a)(3)(ii).

VIII. Pursuant to 40 CFR 60.758(e), except as provided in 40 CFR 60.752(b)(2)(i)(B), the Permittee shall keep up-to-date, readily accessible records of all collection and control system exceedances of the operational standards in 40 CFR 60.753, the reading in the subsequent month whether or not the second reading is an exceedance, and the location of each exceedance.

d. i. **Hazardous Air Pollutant Requirements (HAP)**

A. I. Pursuant to 40 CFR 63.1955(a), the Permittee shall comply with the requirements of 40 CFR Part 60, Subpart WWW as shown in Condition 4.1.2(c).

II. Pursuant to 40 CFR 63.1955(b), the Permittee must comply with the requirements in Condition 4.1.2(d)(ii)(A) and (B) and 4.1.5((b)((i)(D) and 40 CFR 63.1960 through 63.1985 and with the general provisions of 40 CFR 63 Subpart A specified in table 1 of 40 CFR 63 Subpart AAAA and Section 7.4(a) of this permit.

III. Pursuant to 40 CFR 63.1955(c), for approval of collection and control systems that include any alternatives to the operational standards, test methods, procedures, compliance measures, monitoring, recordkeeping or reporting provisions, the Permittee must follow the procedures in 40 CFR 60.752(b)(2). If alternatives have already been approved under 40 CFR 60 Subpart WWW, these alternatives can be used to comply with 40 CFR 63 Subpart AAAA.

ii. **Compliance Method (HAP Requirements)**

General and Continuing Compliance Requirements

A. I. Pursuant to 40 CFR 63.1960, compliance shall be determined as per the requirements in Condition 4.1.2(c)(ii), including performance testing, monitoring of the collection system, continuous parameter monitoring, and other credible evidence. In addition, continuous parameter monitoring data, collected pursuant to Condition 4.1.2(c)(ii)(B)(II)(1), shall be used to demonstrate compliance with the operating conditions for control systems. If a deviation occurs, the Permittee shall have failed to meet the control device operating conditions described in Condition 4.1.2(c)(i)(A)(III) pursuant to 40 CFR 60 Subpart WWW and have deviated from the requirements of 40 CFR 63 Subpart AAAA. Finally, the Permittee must develop a written SSM plan according to the provisions in 40 CFR 63.6(e)(3). A copy of the SSM plan must be maintained on site. Failure to write or maintain a copy of the SSM plan is a deviation from the requirements of 40 CFR 63 Subpart AAAA.

II. 1. Pursuant to 40 CFR 63.1965, a deviation is defined in 40 CFR 63.1990. For the purposes of the landfill monitoring and SSM plan requirements, deviations include the following.

a. Pursuant to 40 CFR 63.1965(a), a deviation occurs when the control device operating parameter boundaries described in 40 CFR 60.758(c)(1) of Subpart WWW are exceeded.

b. Pursuant to 40 CFR 63.1965(b), a deviation occurs when 1 hour or more of the hours during the 3-hour block averaging period does not constitute a valid hour of data. A valid hour of data must have measured values for at least three 15-minute monitoring periods within the hour.

c. Pursuant to 40 CFR 63.1965(c), a deviation occurs when a SSM plan is not developed or maintained on site.

III. Pursuant to 40 CFR 63.1975, the following are not to be included in any average computed under 40 CFR 63 Subpart AAAA:

1. Monitoring system breakdowns, repairs, calibration checks, and zero (low-level) and high-level adjustments.

2. Startups.

3. Shutdowns.

4. Malfunctions.

Recordkeeping

B. I. Pursuant to 40 CFR 63.1980(a), the Permittee shall keep records as specified in Conditions 4.1.2(c)(ii)(D)(II) through (VIII) pursuant to 40 CFR 60 Subpart WWW.

II. Pursuant to 40 CFR 63.1980(b) and 40 CFR 60.7(b) and 63.10(b)(2)(ii), the Permittee must keep and maintain the following general records:

1. Pursuant to 40 CFR 63.10(b)(2)(i), the occurrence and duration of each startup or shutdown when the startup or shutdown causes the source to exceed any applicable emission limitation;

2. Pursuant to 40 CFR 60.7(b) and 63.10(b)(2)(ii), the occurrence and duration of each malfunction of operation of the landfill and/or gas collection system, or the required air pollution control, or any periods during which a continuous monitoring system or monitoring device is inoperative;

3. Pursuant to 40 CFR 63.10(b)(2)(iii), all required maintenance performed on the air pollution control and monitoring equipment;

4. Pursuant to 40 CFR 63.10(b)(2)(iv)(A), actions taken during periods of startup or shutdown when the source exceeded applicable emission limitations in a relevant standard and when the actions taken are different from the procedures specified in the affected source's startup, shutdown, and malfunction plan (see §63.6(e)(3));

5. Pursuant to 40 CFR 63.10(b)(2)(B), actions taken during periods of malfunction (including corrective actions to restore malfunctioning process and air pollution control and monitoring equipment to its normal or usual manner of operation) when the actions taken are different from the procedures specified in the affected source's startup, shutdown, and malfunction plan (see §63.6(e)(3)); or

6. Pursuant to 40 CFR 63.10(b)(2)(v), all information necessary, including actions taken, to demonstrate conformance with the affected source's startup, shutdown, and malfunction plan (see §63.6(e)(3)) when all actions taken during periods of startup or shutdown (and the startup or shutdown causes the source to exceed any applicable emission limitation in the relevant emission standards), and malfunction (including corrective actions to restore malfunctioning process and air pollution control and monitoring equipment to its normal or usual manner of operation) are consistent with the procedures specified in such plan. (The information needed to demonstrate conformance with the startup, shutdown, and malfunction plan may be recorded using a "checklist", or some other effective form of recordkeeping, in order to minimize the recordkeeping burden for conforming events);

Applicable records include but are not limited to items such as SSM plans.

III. Pursuant to 40 CFR 63.1980(g), if the Permittee adds any liquids other than leachate in a controlled fashion to the waste mass then the Permittee must keep a record of calculations showing that the percent moisture by weight expected in the waste mass to which liquid is added is less than 40 percent. The calculation must consider the waste mass, moisture content of the incoming waste, mass of water added to the waste including leachate recirculation and other liquids addition and precipitation, and the mass of water removed through leachate or other water losses. Moisture level sampling or mass balances calculations can be used. The Permittee must document the calculations and the basis of any assumptions. Keep the record of the calculations until the Permittee ceases liquids addition.

Pursuant to Condition 3.1(d)(ii), documentation and data required in Condition 4.1.2(d) for ADS Zion Landfill shall be included as part of the above referenced record.

e. i. **Asbestos**

A. I. Pursuant to 40 CFR 61.151, the Permittee shall operate any inactive (asbestos) waste disposal site, as defined in 40 CFR 61.141, i.e., the site has not received any new deposits of asbestos-containing waste material (ACWM) within the past calendar year, as follows:

1. Comply with one of the following:

   a. Pursuant to 40 CFR 61.151(a)(1), either discharge no visible emissions to the outside air from an inactive waste disposal site subject to 40 CFR 61.151; or

   b. Pursuant to 40 CFR 61.151(a)(2), cover the ACWM with at least 15 centimeters (6 inches) of compacted nonasbestos-containing material, and grow and maintain a cover of vegetation on the area adequate to prevent exposure of the ACWM; or

   c. Pursuant to 40 CFR 61.151(a)(3), cover the asbestos-containing waste material with at least 60 centimeters (2 feet) of compacted nonasbestos-containing material, and maintain it to prevent exposure of the asbestos-containing waste; or

   d. Pursuant to 40 CFR 61.151(a)(4), for inactive waste disposal sites for asbestos tailings, a resinous or petroleum-based dust suppression agent that effectively binds dust to control surface air emissions may be used instead of the methods listed above and in 40 CFR 61.151(a) (1), (2), and (3). Use the agent in the manner and frequency recommended for the particular asbestos tailings by the manufacturer of the dust suppression agent to achieve and maintain dust control. Obtain prior written approval of the Illinois EPA Compliance Section or USEPA to use other equally effective dust suppression agents. For purposes of this paragraph, any used, spent, or other waste oil is not considered a dust suppression agent.

2. Pursuant to 40 CFR 61.151(b), unless a natural barrier adequately deters access by the general public, install and maintain warning signs and fencing as required in 40 CFR 61.151(b), or comply with 40 CFR 61.151(a)(2) or (a)(3).

3. Pursuant to 40 CFR 61.151(c), the Permittee may use an alternative control method that has received prior approval of the Illinois EPA or USEPA rather than comply with the requirements of 40 CFR 61.151(a) or (b).

4. Pursuant to 40 CFR 61.151(e), within 60 days of a site becoming inactive, record, in accordance with State law, a notation on the deed to the facility property and on any other instrument that would normally be examined during a title search; this notation will in perpetuity notify any potential purchaser of the property that:

   a. The land has been used for the disposal of asbestos-containing waste material;

   b. The survey plot and record of the location and quantity of asbestos-containing waste disposed of within the disposal site required in 40 CFR 40 CFR 61.154(f) have been filed with the Administrator; and

c. The site is subject to 40 CFR Part 61, Subpart M.

II. Pursuant to 40 CFR 61.154, the Permittee shall operate any active (asbestos) waste disposal site that receives ACWM as follows:

1. Pursuant to 40 CFR 61.154(a), either there must be no visible emissions to the outside air from any active waste disposal site where ACWM has been deposited, or the requirements of 40 CFR 61.154(c) or (d) must be met.

2. Pursuant to 40 CFR 61.154(b), unless a natural barrier adequately deters access by the general public, either warning signs and fencing must be installed and maintained as shown in 40 CFR 61.154(b), or the requirements of 40 CFR 61.154(c)(1) must be met.

3. Pursuant to 40 CFR 61.154(c), rather than meet the no visible emission requirement of 40 CFR 61.154(a), at the end of each operating day, or at least once every 24-hour period while the site is in continuous operation, the asbestos-containing waste material that has been deposited at the site during the operating day or previous 24-hour period shall:

a. Pursuant to 40 CFR 61.154(c)(1), be covered with at least 15 centimeters (6 inches) of compacted nonasbestos-containing material, or

b. Pursuant to 40 CFR 61.154(c)(2), be covered with a resinous or petroleum-based dust suppression agent that effectively binds dust and controls wind erosion. Such an agent shall be used in the manner and frequency recommended for the particular dust by the dust suppression agent manufacturer to achieve and maintain dust control. Other equally effective dust suppression agents may be used upon prior approval by the Illinois EPA or USEPA. For purposes of this paragraph, any used, spent, or other waste oil is not considered a dust suppression agent.

4. Pursuant to 40 CFR 61.154(d), rather than meet the no visible emission requirement of 40 CFR 61.154(a), use an alternative emissions control method that has received prior written approval by the Administrator according to the procedures described in 40 CFR 61.149(c)(2).

5. Pursuant to 40 CFR 61.154(g), upon closure of the active waste disposal site, the Permittee shall comply with all the provisions of 40 CFR 61.151.

ii. <u>**Compliance Method (Asbestos Requirements)**</u>

<u>Monitoring</u>

A. Pursuant to Sections 39.5(7)(b) and (d) of the Act, the Permittee shall perform a monthly inspection on all active ACWM disposal sites at the source to demonstrate compliance with the visible emissions and/or cover requirements of Condition 4.1.2(e)(i)(A) and 40 CFR 61.151(a) and 61.154(c). If the cover at the site is not in compliance with the ACWM cover requirements, pursuant to Condition 4.1.2(e)(i)(A) and 40 CFR 61.151(a) and

61.154(c), or if ACWM is exposed, the Permittee shall either monitor for visible emissions using USEPA RM 22 or take corrective action within 4 hours of the observation of exposed ACWM, in accordance with the cover and or control requirements Condition 4.1.2(e)(i)(A) and 40 CFR 61.151(a) and 61.154(c), as applicable. All inspections and/or corrective actions and data as per RM 22 must be documented. The monthly cover integrity survey conducted in accordance with 40 CFR 60.755(c)(5) and Condition 4.1.2(c)(ii)(A)(IV)(5) may be conducted and documented concurrently with the asbestos cover integrity survey.

Recordkeeping

B. I. Pursuant to 40 CFR 61.154(e), for all asbestos-containing waste material received, the Permittee shall:

1. Pursuant to 40 CFR 61.154(e)(1), maintain waste shipment records, using a form similar to that shown in Figure 4 of 40 CFR 61 Subpart M, and include the following information:

a. The name, address, and telephone number of the waste generator.

b. The name, address, and telephone number of the transporter(s).

c. The quantity of the ACWM in cubic meters (cubic yards).

d. The presence of improperly enclosed or uncovered waste, or any asbestos-containing waste material not sealed in leak-tight containers. Report in writing to the Illinois EPA Compliance Section, by the following working day, the presence of a significant amount of improperly enclosed or uncovered waste. Submit a copy of the waste shipment record along with the report.

e. The date of the receipt.

2. Pursuant to 40 CFR 61.154(e)(2), as soon as possible, and no longer than 30 days after receipt of the waste, send a copy of the signed waste shipment record to the waste generator.

3. Pursuant to 40 CFR 61.154(e)(3), upon discovering a discrepancy between the quantity of waste designated on the waste shipment records and the quantity actually received, attempt to reconcile the discrepancy with the waste generator. If the discrepancy is not resolved within 15 days after receiving the waste, immediately report in writing to the Illinois EPA Compliance Section. Describe the discrepancy and attempts to reconcile it, and submit a copy of the waste shipment record along with the report.

II. Pursuant to 40 CFR 61.154(e), maintain, until closure, records of the location, depth and area, and quantity in cubic meters (cubic yards) of asbestos-containing waste material within the disposal site on a map or diagram of the disposal area.

III. Pursuant to Sections 39.5(7)(b) and (e) of the Act, the Permittee shall collect and maintain the records of the inspections and/or corrective actions and data as per RM 22 required pursuant to Condition 4.1.2(e)(i)(A).

f. i. **Odor Requirements**

A. I. Pursuant to Construction Permit 06100001, 11030009, and 12070062, In the event that the operation of the landfill gas collection and control system results in an odor nuisance or any other nuisance due to the operation of the flares or through any other cause, the Permittee shall take all appropriate and necessary action, including but not limited to, additional work practices for handling of waste; enhancements to the gas collection system; changes in operating procedures or installation of additional air pollution control equipment, in order to eliminate the nuisance. [T1]

II. Pursuant to Section 9(a) of the Act, no person shall cause or threaten to allow the discharge or emission of any contaminant into the environment of any state so as to cause or tend to cause air pollution in Illinois, either alone or in combination with contaminants from other sources, or so as to violate regulations or standards adopted under this Act.

III. Pursuant to Section 39.5(7)(a) of the Act, the Permittee shall take appropriate and necessary actions to minimize odors, these include but are not limited to the following:

- Early application of daily or intermediate cover;
- Separation and/or sequestration of odoriferous waste;
- Application of temporary tarps or plastic sheeting;
- Adjustments to the landfill gas collection system;
- Maintenance on landfill components; and/or
- Application of low VOM (<1% by wt.) deodorizers or neutralizers, e.g., use of the ECOLO odor control product referenced in Condition 6.2.

ii. **Compliance Method (Odor Requirements)**

Monitoring

A. Pursuant to Section 39.5(7)(b) and (d) of the Act, the Permittee shall conduct weekly inspections of source's operations and evaluate releases of odors from those operations until at least 4 weeks of data indicates that no odor nuisance exists. Thereafter; monitoring may switch to a monthly basis. Monitoring shall revert to the weekly basis if a deviation is detected. Monthly monitoring may resume after another 4 weeks of data again indicates no deviations.

B. Pursuant to Section 39.5(7)(b) and (d) of the Act, any citizen's odor complaints submitted directly to the source shall be evaluated within 72 hours from the date of receipt and the Permittee shall make all reasonable efforts to reduce or eliminate the cause of such odors.

Recordkeeping

C. Pursuant to Section 39.5(7)(b) and (e) of the Act, the Permittee shall keep the records of any inspections; evaluations; assessments and/or identifications of odors being released; if applicable, copies of any odor control plans or standard operating procedures in regard to odors and/or odor complaints; and logs of any appropriate and necessary corrective actions taken which may include but is not limited to the actions listed in Condition 4.1.2(f)(i)(A)(III).

The Permittee shall document whether or not odors were detected during either the odor inspection or investigation of a citizen's odor complaint and whether or not a specific odor or odor complaint could or could not be localized or attributed to ADS Zion Landfill or another source.

3. Non-Applicability Determinations

a. The MSW landfill is not subject to 35 IAC 220, Nonmethane Organic Compounds because, pursuant to 35 IAC 220.200(b), any MSW landfill that commenced construction, reconstruction, or modification on or after May 30, 1991, is subject to the requirements of 40 CFR 60, Subpart WWW, in lieu of the requirements of 35 IAC 220.

b. The MSW landfill and fugitive PM operations are not subject to 35 IAC 212.321 or 212.322, due to the unique nature of the unit(s), a process weight rate cannot be set so that such rules cannot reasonably be applied, pursuant to 35 IAC 212.323.

c. The MSW landfill is not subject to 40 CFR Part 64, Compliance Assurance Monitoring (CAM) for Major Stationary Sources in regard to VOM/NMOC emissions, because the MSW landfill is subject to a NESHAP, i.e., 40 CFR Part 63 Subpart AAAA - National Emission Standards for Hazardous Air Pollutants: Municipal Solid Waste Landfills, that was proposed after November 15, 1990, pursuant to 40 CFR 64.2(b)(1)(i), and the NESHAP requires sufficient monitoring for the associated control devices, i.e., the open and enclosed flares listed in Condition 4.1.1, via compliance with 40 CFR Part 60 Subpart WWW - Standards of Performance for Municipal Solid Waste Landfills.

d. The MSW landfill is not subject to 40 CFR Part 64, Compliance Assurance Monitoring (CAM) for Major Stationary Sources in regard to NO_x, CO, SO_2, PM/PM_{10}, and Asbestos emissions, because the landfill does not use an add-on control device to achieve compliance with an emission limitation or standard for the listed pollutants.

e. Pursuant to the criteria in 40 CFR 64.2(b)(2), the open and enclosed flares, listed in Condition 4.1.1, are not subject to 40 CFR Part 64, Compliance Assurance Monitoring (CAM) for Major Stationary Sources in regard to NO_x, CO, SO_2, PM/PM_{10}, and VOM/NMOC emissions, because neither of the flares use an add-on control device to achieve compliance with an emission limitation or standard.

4. Other Requirements

For the emission units in Condition 4.1.1 above, the Permittee shall comply with the following applicable requirements pursuant to Sections 39.5(7)(a), 39.5(7)(b), and 39.5(7)(d) of the Act.

a. i. **Title I Requirements [T1])**

A. **Title I Requirements (Construction Permit 06100001 [T1])**

Pursuant to Construction Permit 06100001 and the open and enclosed flares referenced in Condition 4.1.1, the Permittee shall comply with the following: [T1]

I. The design capacity of the enclosed flare shall not exceed 6,000 scfm of LFG.

II. The design capacity of the open flare shall not exceed 3,000 scfm of LFG.

III. Emissions of the open and enclosed flares shall not exceed the following limits:

	Limit			
	Emission Factor (lb/million scf of LFG)		Hourly (lb/hr)	Annual (ton/yr)
Pollutant	Enclosed	Open		
NO_x	30.0	30.9	7.2	31.5
CO	100	168	45.66	200.0
VOM			2.8	12.3

PM			1.0	4.4
Total HAPs			0.5	2.2

IV. Notwithstanding the above, the hourly emissions of NO_x from the open and enclosed flares may exceed 7.2 pounds per hour, when the flares are operated during period of reduced capacity or outage of the associated Bio Energy (Illinois) LLC gas-to-energy facility referenced in Condition 1.3(a). During such periods, hourly emissions of NO_x from the open and enclosed flares and engines at the Bio Energy (Illinois) LLC gas-to-energy facility, in total, shall not exceed 36.4 pounds per hour, which is the total of the permitted hourly NO_x emissions of the engines during normal operation, 29.2 pounds per hour, and the permitted NO_x emissions of the affected flares during normal operation, 7.2 pounds per hour.

B. **Title I Requirements (Construction Permit 11030009 [T1])**

Pursuant to Construction Permit 11030009, in regard to the open and enclosed flares referenced in Condition 4.1.1 the Permittee shall comply with the following: [T1]

I. The emissions from flaring LFG at the affected landfill shall not exceed the following:

Pollutant	Limit Emission Factor (lb/million scf of LFG) Enclosed Flare	 Open Flare
NO_x	30.0	30.9
CO	100	168

II. The total emissions of the enclosed flare and open flare including emissions from flaring LFG from the vertical expansion of ADS Zion landfill, authorized in Construction Permit 11030009, shall not exceed the following limits

Pollutant	Hourly (lb/hr)	Annual (ton/yr)
CO	45.66	200.0
VOM/NMOC	2.8	12.3
PM/PM_{10}	1.0	4.4
Total HAPs	0.5	2.2

III. 1. The total emissions from combustion of LFG attributable to the existing landfill shall not exceed the following limits:

Pollutant	Monthly (ton/mo)	Annual (ton/yr)
NO_x	16.0	160.0

2. Total emissions of NO_x from the combustion of LFG attributable to the vertical expansion of ADS Zion landfill, covered in Construction Permit 11030009, shall not exceed 4.0 tons/month and 32.0 tons/year. [T1]

C. **Title I Requirements (Construction Permit 12070062 [T1])**

Pursuant to Construction Permit 12070062 and the landfill and open and enclosed flares referenced in Condition 4.1.1, the Permittee shall comply with the following: [T1]

I. The design capacity of the affected landfill shall not exceed 29.2 million cubic yards of waste.

II. The total emissions of the flares (the enclosed flare and open flare), including emissions from flaring LFG from the expansion authorized by Construction Permit 12070062, shall not exceed the following limits.

Pollutant	Hourly (lb/hr)	Annual (ton/yr)
CO	45.7	200
VOM/NMOC	2.8	12.3
PM/PM_{10}	1.0	4.4
Total HAPs	1.8	7.9

III. The NO_x emissions from the control of the LFG collected from the expansion authorized by Construction Permit 12070062 shall not exceed 7.2 lbs/hour and 32 tons/year.

ii. **Compliance Method**

A. Pursuant to Construction Permits 06100001, 11030009, and 12070062, compliance with annual limits shall be determined from a running total of 12 months of data i.e., the sum of emissions data for the month of record plus the preceding 11 months of data. [T1]

B. Pursuant to 39.5(7)(b) and (d) of the Act and Construction Permit 06100001, 11030009, and 12070062, for purposes of determining compliance with the limits in Condition 4.1.4(a)(i)(A), (B), and (C), emissions shall be determined using site-specific data for the generation, disposition and composition of LFG and appropriate emission factors, which in order of preference for pollutants shall be factors from on-site emission testing, manufacturer's emission data, and emission factors from USEPA's Compilation of Air Pollutant Emission Factors (AP-42) with appropriate adjustments to this data and these emission factors to reflect source-specific conditions and any deficiencies in the collection of LFG and operation of units controlling LFG at this affected source.

C. Pursuant to 39.5(7)(b) and (d) of the Act and Construction Permits 12070062, the Permittee shall install, maintain, and operate instrumentation to continuously measure the total amount of LFG collected from the affected landfill, in scf, and the disposition of this LFG as follows:

I. The amount of LFG sent to the associated gas-to-energy facility, referenced in Condition 1.3(a).

II. The amount of LFG sent to each flare, on a daily basis.

III. In addition to the hourly data automatically recorded by these instrumentation, the Permittee shall compile and record data from these instrumentations for the total amount of LFG collected from the affected landfill and its disposition on a monthly basis (per month and running total of 12-months).

As an alternative to continuous monitoring for the amount of LFG sent to the gas-to-energy facility, as addressed by Condition 1.3(a)(C)(I), the Permittee may obtain this data from the owner or operator of this facility (scf/month).

iii. **Recordkeeping**

A. I. Pursuant to Construction Permits 06100001, the Permittee shall keep the following records pursuant to the enclosed and open flares;

1. A file for emission factors used for calculating the emissions and the maximum hourly emissions of the enclosed and open flares during different operating modes of the source, with supporting documentation.

2. Monthly and annual emissions of NO_x, CO, VOM, PM, and HAPs from the affected flares, with supporting calculations (tons/month and tons/year).

3. During periods when the enclosed and open flares are operating during reduced capacity or outage of the gas-to-energy facility, referenced in Condition 1.3(a), operating records to show that the applicable annual limits in Condition 4.2.4(a)(i)(A) are met.

II. Pursuant to Construction Permits 11030009, the Permittee shall keep the following records pursuant to the enclosed and open flares;

1. Total consumption of LFG by the flares, on a daily basis.

2. Operating Records:

(a) A file containing the design specifications for each flare including capacity, scfm, and a demonstration that the open flare complies with applicable operating requirements of 40 CFR 60.18 (e.g., gas heat content and exit velocity) and the enclosed flare complies with the applicable requirements of 40 CFR 60 Subpart WWW.

(b) An operating log that shall include the following:

(i) Status of the flare.

(ii) Adjustments of flare's operating parameters.

(iii) Identification of any period when the flare was to be in service but was out of service with a detailed explanation of the cause and an explanation of actions taken to prevent or reduce the likelihood of future occurrences.

(c) An inspection/maintenance log that shall include the following:

(i) Date of inspection and observed condition of the flare.
(ii) Date and description of maintenance performed.

(d) Records related to emissions of the flares:

(i) A file containing: 1) The emission factors used by the Permittee for calculating emissions of NO_x, CO, PM, and VOM with supporting documentation; and 2) Engineering calculations for the maximum hourly emissions of NO_x, CO, PM, NMOC and VOM from each flare.

(ii) Emissions NO_x, CO, PM, VOM, NMOC, and HAPs from each flare (tons/month and tons/year), with supporting calculations.

III. Pursuant to Construction Permits 12070062, the Permittee shall keep the following records pursuant to the enclosed and open flares;

1. The Permittee shall keep a record for the design capacity of the affected landfill, with supporting documentation.

2. (a) The Permittee shall keep records of the total amount of LFG collected from the affected landfill and its disposition, i.e., the amount of LFG sent to the gas-to-energy facility and to each flare (scf/month and scf/year), with supporting documentation.

(b) The Permittee shall keep monthly records of the split between LFG generated by the affected landfill that is attributable to the existing source, i.e., the landfill excluding the expansion authorized by Construction Permits 12070062, and LFG that is attributable to the expansion of the landfill authorized by Construction Permits 12070062.

3. Permittee shall keep the following records related to emissions of each flare:

(a) A file containing the current data used by the Permittee to calculate emissions from each flare used to control collected LFG, as follows, with supporting documentation:

(i) The emission factors for NO_x, CO, PM, and PM_{10}.

(ii) The VOM and NMOC content of the LFG and the control efficiency for each of these pollutants.

(iii) For HAPs, HAP contents of the LFG and the factors for generation of emissions of HAPs when the LFG is controlled.

(b) Records of NO_x, CO, PM, VOM and HAPs (tons/month and tons/year), with supporting calculations.

5. Reporting Requirements

The Permittee shall submit the following information pursuant to Section 39.5(7)(f) of the Act. Addresses are included in Attachment 2.

a. Prompt Reporting

i. A. Pursuant to Section 39.5(7)(f)(ii) of the Act, the Permittee shall promptly notify the IEPA Air Compliance Section within 30 days of deviations from applicable requirements as follows unless a different period is specified by a particular permit provision, i.e., NSPS or NESHAP requirement:

I. Requirements in Conditions 4.1.2(a)(i), 4.1.2(b)(i), 4.1.2(c)(i), 4.1.2(d)(i), and 4.1.2(e)(i);

II. Requirements in Conditions 4.1.4(a)(i)

ii. The deviation reports shall contain at a minimum the following information:

A. Date and time of the deviation.

B. Emission unit(s) and/or operation involved.

C. The duration of the event.

D. Probable cause of the deviation.

E. Corrective actions or preventative measures taken.

iii. All such deviations shall be summarized and reported as part of the Semiannual Monitoring Report required by Condition 3.6(b).

b. **Federal Reporting**

i. A. Pursuant to 40 CFR 60.757(d), the owner or operator of a controlled landfill shall submit a closure report to the Illinois EPA Compliance Section within 30 days of waste acceptance cessation. The Illinois EPA may request additional information as may be necessary to verify that permanent closure has taken place in accordance with the requirements of 40 CFR 258.60. If a closure report has been submitted to the Illinois EPA, no additional wastes may be placed into the landfill without filing a notification of modification as described under 40 CFR 60.7(a)(4).

B. Pursuant to 40 CFR 60.757(e), the owner or operator of a controlled landfill shall submit an equipment removal report to the Illinois EPA Compliance Section 30 days prior to removal or cessation of operation of the control equipment.

I. Pursuant to 40 CFR 60.757(e)(1), the equipment removal report shall contain all of the following items:

1. A copy of the closure report submitted in accordance with paragraph (d) of this section;

2. A copy of the initial performance test report demonstrating that the 15 year minimum control period has expired; and

3. Dated copies of three successive NMOC emission rate reports demonstrating that the landfill is no longer producing 50 megagrams or greater of NMOC per year.

II. Pursuant to 40 CFR 60.757(e)(2), the Illinois EPA may request such additional information as may be necessary to verify that all of the conditions for removal in 40 CFR 60.752(b)(2)(v) have been met.

C. I. Pursuant to 40 CFR 63.1980(a), the Permittee shall submit reports as specified in 40 CFR 60 Subpart WWW, whichever applies to the affected MSW landfill, with one exception: The Permittee must submit the annual report described in 40 CFR 60.757(f) by July 30 and January 30.

II. Pursuant to 40 CFR 63.1980(b), the Permittee must also submit reports as specified in the general provisions of 40 CFR Part 60 Subpart A and 40 CFR Part 63 as shown in Table 1 of 40 CFR 63 Subpart AAAA. Applicable records in the general provisions include items such as SSM plans.

III. Pursuant to 40 CFR 60.757(f), the recorded information shown below and in 40 CFR 60.757(f)(1) through (f)(6) shall be submitted in the semi-annual reports required in Condition 4.1.5(b)(i)(D)(I) and in 40 CFR 63.1980(a). Reportable exceedances are defined under Condition 4.1.2(c)(ii)(D)(VII) and 40 CFR 60.758(c).

1. Value and length of time for exceedance of applicable parameters monitored under 40 CFR 60.756(a), (b), (c), and (d).

2. Description and duration of all periods when the gas stream is diverted from the control device through a bypass line or the indication of bypass flow as specified under 40 CFR 60.756.

3. Description and duration of all periods when the control device was not operating for a period exceeding 1 hour and length of time the control device was not operating.

4. All periods when the collection system was not operating in excess of 5 days.

5. The location of each exceedance of the 500 parts per million methane concentration as provided in 40 CFR 60.753(d) and the concentration recorded at each location for which an exceedance was recorded in the previous month.

6. The date of installation and the location of each well or collection system expansion added pursuant to 40 CFR 60.755(a)(3), (b), and (c)(4).

D. Pursuant to 40 CFR 60.757(g), the Permittee shall include the following information with the initial performance test report required under 40 CFR 60.8:

I. A diagram of the collection system showing collection system positioning including all wells, horizontal collectors, surface collectors, or other gas extraction devices, including the locations of any areas excluded from collection and the proposed sites for the future collection system expansion;

II. The data upon which the sufficient density of wells, horizontal collectors, surface collectors, or other gas extraction devices and the gas mover equipment sizing are based;

III. The documentation of the presence of asbestos or nondegradable material for each area from which collection wells have been excluded based on the presence of asbestos or nondegradable material;

IV. The sum of the gas generation flow rates for all areas from which collection wells have been excluded based on nonproductivity and the calculations of gas generation flow rate for each excluded area;

V. The provisions for increasing gas mover equipment capacity with increased gas generation flow rate, if the present gas mover equipment is inadequate to move the maximum flow rate expected over the life of the landfill; and

VI. The provisions for the control of off-site migration.

E. I. Pursuant to 40 CFR 61.151(d) and 61.154(j), the Permittee shall notify the Illinois EPA Compliance Section in writing at least 45 days prior to excavating or otherwise disturbing any asbestos-containing waste material that has been deposited at a waste disposal site and covered as per 40 CFR 61.151 or 61.154, and follow the procedures specified in the notification. If the excavation will begin on a date other than the one contained in the original notice, notice of the new start date must be provided to the Illinois EPA Compliance Section at least 10 working days before excavation begins and in no event shall excavation begin earlier than the date specified in the original notification. Include the following information in the notice:

1. Scheduled starting and completion dates.

2. Reason for disturbing the waste.

3. Procedures to be used to control emissions during the excavation, storage, transport, and ultimate disposal of the excavated asbestos-containing waste material. If deemed necessary, the Administrator may require changes in the emission control procedures to be used.

4. Location of any temporary storage site and the final disposal site.

II. Pursuant to 40 CFR 61.154(e)(1)(iv), the Permittee shall report in writing to the Illinois EPA Compliance Section, by the following working day, the presence of a significant amount of improperly enclosed or uncovered waste. Submit a copy of the waste shipment record, required in 40 CFR 61.154(e), along with the report.

III. Pursuant to 40 CFR 61.154(e)(1)(iv), if the discrepancy between the quantity of waste designated on the waste shipment records and the quantity actually received is not resolved within 15 days after receiving the waste, as per 40 CFR 61.154(e)(1)(iv), the Permittee shall immediately report in writing to the Illinois EPA Compliance Section. Describe the discrepancy and attempts to reconcile it, and submit a copy of the waste shipment record, required in 40 CFR 61.154(e), along with the report.

IV. Pursuant to 40 CFR 61.154(h), the Permittee shall submit to the Illinois EPA Compliance Section, upon closure of the facility, a copy of records of asbestos waste disposal locations and quantities, required in 40 CFR 61.154(f).

4.2 Gasoline Dispensing Operation

1. Emission Units and Operations

Emission Units	*Pollutants Being Regulated*	*Original Construction Date*	*Modification/ Reconstruction Date*	*Air Pollution Control Devices or Measures*	*Monitoring Devices*
500 Gallon Gasoline Storage Tank	VOM	--	--	Submerged Loading	None

2. Applicable Requirements

For the emission units in Condition 4.2.1 above, the Permittee shall comply with the following applicable requirements pursuant to 39.5(7)(a), 39.5(7)(b), and 39.5(7)(d) of the Act.

a. i. **State Work Practice Requirements**

A. Pursuant to 35 IAC 218.583(a)(1), no person shall cause or allow the transfer of gasoline from any delivery vessel into any stationary storage tank for the gasoline dispensing operation unless the tank is equipped with a submerged loading pipe.

ii. Periodic **Monitoring** Compliance Method (VOM **Requirements)**

Monitoring

A. Pursuant to Section 39.5(7)(b) and (d) of the Act, the Permittee shall conduct semi-annual inspections of the gasoline storage tank and dispensing operation while the tank is being filled by inspecting the submerged loading pipe is physically present and the condition of the pipe for integrity.

Recordkeeping

B. Pursuant to Section 39.5(7)(b) and (e) of the Act, the Permittee shall maintain the records of conducted inspections, with a date and results of such inspections.

C. Pursuant to Section 39.5(7)(b) and (e) of the Act, the Permittee shall keep a copy of operating instructions and maintenance log.

b. i. **HAP Emissions** - Work Practice Requirements **(40 CFR 63 Subpart CCCCCC)**

A. Pursuant to 40 CFR 63.1116(a), the Permittee shall fulfill at least the following requirements in regards to the gasoline dispensing operation with monthly throughput of less than 10,000 gallons of gasoline:

I. Minimize gasoline spills;

II. Clean up spills as expeditiously as practicable;

III. Cover all open gasoline containers and all gasoline storage tank fill-pipes with a gasketed seal when not in use; and

IV. Minimize gasoline sent to open waste collection systems that collect and transport gasoline to reclamation and recycling devices, such as oil/water separators.

B. Pursuant to 40 CFR 63.11111(j), the dispensing of gasoline from a fixed gasoline storage tank at the gasoline dispensing facility into a portable gasoline tank for the on-site delivery and subsequent dispensing of the gasoline into the fuel tank of a motor vehicle or other gasoline-fueled engine or equipment used within the area source is only subject to Condition 4.2.2(b)(i)(A) and 40 CFR 63.11116.

C. Pursuant to 40 CFR 63.11130, the Permittee must comply with the applicable general provisions specified in the general provisions of 40 CFR Part 63 as shown in Table 3 of 40 CFR 63 Subpart CCCC and Section 7.4(b) of this permit.

ii. **Compliance Method (Federal Work Practice Requirements)**

Monitoring

A. Pursuant to Section 39.5(7)(b) and (d) of the Act, the Permittee shall conduct semi-annual inspections of the gasoline storage tank and dispensing operation to ensure that the operating requirements established by Condition 4.2.2(b)(i)(A) and 40 CFR 63.1116(a) are met. The tank shall be inspected while the tank is being filled.

Recordkeeping

B. Pursuant to Section 39.5(7)(b) and (e) of the Act, the Permittee shall keep on site written operating procedures or instructions on how to implement the operating requirements established by Condition 4.2.2(b)(i)(A) and 40 CFR 63.1116(a).

C. Pursuant to Section 39.5(7)(b) and (e) of the Act, the Permittee shall maintain the records of inspections conducted to comply with Condition 4.2.2(a)(ii)(A) with a date and results of such inspections.

D. Pursuant to 40 CFR 63.11111(e), the Permittee shall maintain the records of monthly the gasoline dispensing facility's throughput.

3. Non-Applicability Determinations

a. The gasoline storage tank and associated dispensing operations are not subject to 40 CFR 64, Compliance Assurance Monitoring (CAM) for VOM or HAPs because the tank uses a passive control measure, such as a seal, lid, or roof, that is not considered a control device because it acts to prevent the release of pollutants.

b. The gasoline storage tank is not subject to 35 IAC 215.301 because the gasoline storage tank does not use organic material as defined in 35 IAC 211.4250(b).

c. The gasoline storage tank is not subject to 35 IAC 215.586(c) because the average monthly gasoline throughput is less than 10,000 gallons as limited by Condition 4.2.2(c)(i)(A).

d. The gasoline storage tank is not subject to 35 IAC 215.581 and 215.582 because the tank is not a bulk gasoline plant or bulk gasoline terminal as defined in 35 IAC 211.790 and 211.810, respectively.

e. Pursuant 40 CFR 63.11111(c) and (d), the gasoline dispensing facility is not subject to the requirements of 40 CFR 63.11117 or 63.11118 because the gasoline dispensing facility's monthly throughput is less than 10,000 gallons per month.

4. Other Requirements

As of the date of issuance of this permit, there are no such requirements that need to be included for this gasoline storage tank.

5. Reporting Requirements

The Permittee shall submit the following information pursuant to Section 39.5(7)(f) of the Act. Addresses are included in Attachment 2.

a. **Prompt Reporting**

i. A. Pursuant to Section 39.5(7)(f)(ii) of the Act, the Permittee shall promptly notify the IEPA Air Compliance Section within 30 days of deviations from applicable requirements as follows unless a different period is specified by a particular permit provision, i.e., NSPS or NESHAP requirement:

I. Requirements in Conditions 4.2.2(a), (b), and (c).

B. All such deviations shall be summarized and reported as part of the Semiannual Monitoring Report required by Condition 3.6(b).

ii. The Permittee shall notify the IEPA Air Compliance Section of all other deviations as part of the Semiannual Monitoring Report required by Condition 3.6(b).

iii. The deviation reports shall contain at a minimum the following information:

A. Date and time of the deviation.

B. Emission unit(s) and/or operation involved.

C. The duration of the event.

D. Probable cause of the deviation.

E. Corrective actions or preventative measures taken.

Section 5 - Additional Title I Requirements

This Section is reserved for Title I requirements not specified in Sections 3 or 4. As of the date of issuance of this permit, there are no Title I requirements that need to be separately addressed in this Section.

Section 6 - Insignificant Activities Requirements

1. Insignificant Activities Subject to Specific Regulations

This condition is reserved for insignificant activities, as defined in 35 IAC 201.210 and 201.211, which are subject to specific standards promulgated pursuant Sections 111, 112, 165, or 173 of the Clean Air Act, see Sections 9.1(d) and 39.5(6)(a) of the Act. As of the date of issuance of this permit, there are no such insignificant activities present at the source.

2. Insignificant Activities in 35 IAC 201.210(a)

In addition to any insignificant activities identified in Condition 6.1, the following additional activities at the source constitute insignificant activities pursuant to 35 IAC 201.210 and 201.211:

Insignificant Activity	*Number of Units*	*Insignificant Activity Category*
8,000 gallon Aboveground Leachate/Condensate Storage Tanks	2	35 IAC 201.210(a)(1) and 201.211
160,000 Gallon Aboveground Leachate Storage Tanks	1	35 IAC 201.210(a)(1) and 201.211
32,000 Gallon Aboveground Leachate Storage Tanks	2	35 IAC 201.210(a)(1) and 201.211
Petroleum Contaminated soils as daily cover	1	35 IAC 201.210(a)(1) and 201.211
Use of ECOLO odor control product with propylene glycol additive in winter	1	35 IAC 201.210(a)(1) and 201.211
Direct combustion units used for comfort heating and fuel combustion emission units as further detailed in 35 IAC 201.210(a)(4).	8	35 IAC 201.210(a)(4)
Storage tanks of virgin or rerefined distillate oil, hydrocarbon condensate from natural gas pipeline or storage systems, lubricating oil, or residual fuel oil.	6	35 IAC 201.210(a)(11)
Gas turbines and stationary reciprocating internal combustion engines < 112 kW (150 HP).	7	35 IAC 201.210(a)(15)

3. Insignificant Activities in 35 IAC 201.210(b)

Pursuant to 35 IAC 201.210, the source has identified insignificant activities as listed in 35 IAC 201.210(b)(1) through (28) as being present at the source. The source is not required to individually list the activities.

4. Applicable Requirements

Insignificant activities in Conditions 6.1 and 6.2 are subject to the following general regulatory limits notwithstanding status as insignificant activities. The Permittee shall comply with the following requirements, as applicable:

a. Pursuant to 35 IAC 212.123(a), no person shall cause or allow the emission of smoke or other particulate matter, with an opacity greater than 30 percent, into the atmosphere from any emission unit other than those emission units subject to 35 IAC 212.122, except as provided in 35 IAC 212.123(b).

b. Pursuant to 35 IAC 214.301, no person shall cause or allow the emission of sulfur dioxide into the atmosphere from any process emission source to exceed 2,000 ppm, except as provided in 35 IAC Part 214.

c. Pursuant to 35 IAC 218.122(b), no person shall cause or allow the loading of any organic material into any stationary tank having a storage capacity of greater than 250 gal, unless such tank is equipped with a permanent submerged loading pipe, submerged fill, or an equivalent device approved by the IEPA according to 35 IAC Part 201 or unless such tank is a pressure tank as described in 35 IAC 215.121(a) or is fitted with a recovery system as described in 35 IAC 218.121(b)(2). Exception as provided in 35 IAC 218.122(c):

If no odor nuisance exists the limitations of 35 IAC 218.122 shall only apply to the loading of volatile organic liquid with a vapor pressure of 2.5 psia or greater at 70°F.

5. Compliance Method

Pursuant to Section 39.5(7)(b) of the Act, the source shall maintain records of the following items for the insignificant activities in Conditions 6.1 and 6.2:

a. List of all insignificant activities, including insignificant activities added as specified in Condition 6.6, the categories the insignificant activities fall under, and supporting calculations as needed for any insignificant activities listed in 35 IAC 201.210(a)(1) through (3).

b. Potential to emit emission calculations before any air pollution control device for any insignificant activities listed in 35 IAC 201.210(a)(1) through (3).

6. Notification Requirements for Insignificant Activities

The source shall notify the IEPA accordingly to the addition of insignificant activities:

a. Notification 7 Days in Advance

i. Pursuant to 35 IAC 201.212(b), for the addition of an insignificant activity that would be categorized under 35 IAC 201.210(a)(1) and 201.211 and is not currently identified in Conditions 6.1 or 6.2, a notification to the IEPA Permit Section 7 days in advance of the addition of the insignificant activity is required. Addresses are included in Attachment 2. The notification shall include the following pursuant to 35 IAC 201.211(b):

A. A description of the emission unit including the function and expected operating schedule of the unit.

B. A description of any air pollution control equipment or control measures associated with the emission unit.

C. The emissions of regulated air pollutants in lb/hr and ton/yr.

D. The means by which emissions were determined or estimated.

E. The estimated number of such emission units at the source.

F. Other information upon which the applicant relies to support treatment of such emission unit as an insignificant activity.

ii. Pursuant to 35 IAC 201.212(b), for the addition of an insignificant activity that would be categorized under 35 IAC 201.210(a)(2) through 201.210(a)(18) and is not currently identified in Conditions 6.1 or 6.2, a notification to the IEPA Permit Section 7 days in advance of the addition of the insignificant activity is required. Addresses are included in Attachment 2.

iii. Pursuant to Sections 39.5(12)(a)(i)(B) and 39.5(12)(b)(iii) of the Act, the permit shield described in Section 39.5(7)(j) of the Act (see Condition 2.7) shall not apply to any addition of an insignificant activity noted above.

b. Notification Required at Renewal

Pursuant to 35 IAC 201.212(a) and 35 IAC 201.146(kkk), for the addition of an insignificant activity that would be categorized under 35 IAC 201.210(a) and is currently identified in Conditions 6.1 or 6.2, a notification is not required until the renewal of this permit.

c. Notification Not Required

Pursuant to 35 IAC 201.212(c) and 35 IAC 201.146(kkk), for the addition of an insignificant activity that would be categorized under 35 IAC 201.210(b) as describe in Condition 6.3, a notification is not required.

Section 7 - Other Requirements

1. Testing

a. Pursuant to Section 39.5(7)(a) of the Act, a written test protocol shall be submitted at least sixty (60) days prior to the actual date of testing, unless it is required otherwise in applicable state or federal statutes. The IEPA may at the discretion of the Compliance Section Manager (or designee) accept protocol less than 60 days prior to testing provided it does not interfere with the IEPA's ability to review and comment on the protocol and does not deviate from the applicable state or federal statutes. The protocol shall be submitted to the IEPA, Compliance Section and IEPA, Stack Test Specialist for its review. Addresses are included in Attachment 2. This protocol shall describe the specific procedures for testing, including as a minimum:

   i. The name and identification of the emission unit(s) being tested.

   ii. Purpose of the test, i.e., permit condition requirement, IEPA or USEPA requesting test.

   iii. The person(s) who will be performing sampling and analysis and their experience with similar tests.

   iv. The specific conditions under which testing will be performed, including a discussion of why these conditions will be representative of maximum emissions and the means by which the operating parameters for the emission unit and any control equipment will be determined.

   v. The specific determinations of emissions and operation which are intended to be made, including sampling and monitoring locations.

   vi. The test method(s) that will be used, with the specific analysis method, if the method can be used with different analysis methods. Include if emission tests averaging of 35 IAC 283 will be used.

   vii. Any minor changes in standard methodology proposed to accommodate the specific circumstances of testing, with detailed justification. This shall be included as a waiver of the test procedures. If a waiver has already been obtained by the IEPA or USEPA, then the waiver shall be submitted.

   viii. Any proposed use of an alternative test method, with detailed justification. This shall be included as a waiver of the test procedures. If a waiver has already been obtained by the IEPA or USEPA, then the waiver shall be submitted.

   ix. Sampling of materials, QA/QC procedures, inspections, etc.

b. The IEPA, Compliance Section shall be notified prior to these tests to enable the IEPA to observe these tests pursuant to Section 39.5(7)(a) of the Act as follows:

   i. Notification of the expected date of testing shall be submitted in writing a minimum of thirty (30) days prior to the expected test date, unless it is required otherwise in applicable state or federal statutes.

   ii. Notification of the actual date and expected time of testing shall be submitted in writing a minimum of five (5) working days prior to the actual date of the test. The IEPA may at its discretion of the Compliance Section Manager (or designee) accept notifications with shorter advance notice provided such notifications will not interfere with the IEPA's ability to observe testing.

c. Copies of the Final Report(s) for these tests shall be submitted to the IEPA, Compliance Section within fourteen (14) days after the test results are compiled and finalized but no later than ninety (90) days after completion of the test, unless it is required otherwise in applicable state or federal statutes or the IEPA may at the discretion of the Compliance Section Manager (or designee) agree upon an alternative date in advance pursuant to Section 39.5(7)(a) of the Act. The Final Report shall include as a minimum:

i. General information including emission unit(s) tested.

ii. A summary of results.

iii. Discussion of conditions during each test run (malfunction/breakdown, startup/shutdown, abnormal processing, etc.).

iv. Description of test method(s), including description of sampling points, sampling train, analysis equipment, and test schedule.

v. Detailed description of test conditions, including:

   A. Process information, i.e., mode(s) of operation, process rate, e.g. fuel or raw material consumption.

   B. Control equipment information, i.e., equipment condition and operating parameters during testing.

   C. A discussion of any preparatory actions taken, i.e., inspections, maintenance and repair.

vi. Data and calculations, including copies of all raw data sheets and records of laboratory analyses, sample calculations, and data on equipment calibration.

vii. An explanation of any discrepancies among individual tests or anomalous data.

viii. Results of the sampling of materials, QA/QC procedures, inspections, etc.

ix. Discussion of whether protocol was followed and description of any changes to the protocol if any occurred.

x. Demonstration of compliance showing whether test results are in compliance with applicable state or federal statutes.

d. Copies of all test reports and other test related documentation shall be kept on site as required by Condition 2.5(b) pursuant to Section 39.5(7)(e)(ii) of the Act.

2. Emissions Reduction Market System (ERMS) Requirements

a. Pursuant to 35 IAC Part 205, ERMS seasonal emissions of VOM during the seasonal allotment period from May 1 through September 30 shall not exceed 15 tons/year, not including VOM emissions from insignificant emission units and activities as identified in Section 6 of this permit. This 15 tons/season threshold includes VOM emissions from this source and Bio Energy (Illinois) LLC facility (ID No. 097200ABC), the two of which are considered to be one source, see Condition 1.3.

b. Pursuant to 35 IAC 205, the Permittee shall maintain the following records to determine compliance with the above limitation:

i. Records of operating data and other information for each individual emission unit or group of related emission units at the source, as specified in Sections 3 and 4 of this permit, as appropriate, to determine actual VOM emissions during the seasonal allotment period.

ii. Records of the VOM emissions, in tons, during the seasonal allotment period, with supporting calculations, for each individual emission unit or group of related emission units at the source, determined in accordance with the procedures specified in Sections 3 and 4 of this permit.

iii. Total VOM emissions from the source, in tons, during each seasonal allotment period.

c. Pursuant to 35 IAC 205.205(b) and 35 IAC 205.300, the Permittee shall submit the seasonal emissions component of the Annual Emissions Report by October 31 of each year, reporting actual emissions of VOM during the seasonal allotment period.

d. Pursuant to 35 IAC Section 205.150(c), in the event that the source's VOM emissions during the seasonal allotment period exceed 15 tons, the source shall no longer be exempt from the ERMS and shall immediately comply with 35 IAC Part 205, including holding allotment trading units (ATUs) for its VOM emissions during the first seasonal allotment period it exceeded 15 tons and each seasonal allotment period thereafter.

3. 40 CFR 60 Subpart A Requirements (NSPS)

a. **40 CFR 60 Subpart A and Subpart WWW - Standards of Performance for Municipal Solid Waste (MSW) Landfills**

Pursuant to 40 CFR 60 Subpart A and Subpart WWW, the Permittee shall comply with the following applicable General Provisions as indicated:

General Provision Citation	*Subject of Citation*	*Explanation (if required)*
40 CFR 60.1	General Applicability of the General Provisions	
40 CFR 60.2	Definitions	
40 CFR 60.3	Units and Abbreviations	
40 CFR 60.4	Address	
40 CFR 60.5	Determination of Construction or Modification	
40 CFR 60.6	Review of Plans	
40 CFR 60.7	Notification and Recordkeeping	
40 CFR 60.8	Performance Tests	
40 CFR 60.9	Availability of Information	
40 CFR 60.10	State Authority	
40 CFR 60.11	Compliance with Standards and Maintenance Requirements	
40 CFR 60.12	Circumvention	
40 CFR 60.13	Monitoring Requirements	
40 CFR 60.14	Modification	
40 CFR 60.15	Reconstruction	
40 CFR 60.16	Priority List	
40 CFR 60.17	Incorporations by Reference	
40 CFR 60.18	General Control Device Requirements and Work Practice Requirements	
40 CFR 60.19	General Notification and Reporting Requirements	

4. 40 CFR 63 Subpart A Requirements (NESHAP)

a. 40 CFR 63 Subpart A and Subpart AAAA - National Emission Standards for Hazardous Air Pollutants for Municipal Solid Waste (MSW) Landfills

Pursuant to 40 CFR 63 Subpart A and Subpart AAAA, the Permittee shall comply with the following applicable General Provisions as indicated:

General Provision Citation	*Description*	*Explanation*
63.1(a)	Applicability: general applicability of NESHAP in this part	Affected sources are already subject to the provisions of paragraphs (a)(10)-(12) through the same provisions under 40 CFR, part 60 Subpart A.
63.1(b)	Applicability determination for stationary sources	
63.1(e)	Title V permitting	
63.2	Definitions	
63.4	Prohibited activities and circumvention	Affected sources are already subject to the provisions of paragraph (b) through the same provisions under 40 CFR, Part 60 Subpart A.
63.5(b)	Requirements for existing, newly constructed, and reconstructed sources	
63.6(e)	Operation and maintenance requirements, startup, shutdown and malfunction plan provisions	
63.6(f)	Compliance with non-opacity emission standards	Affected sources are already subject to the provisions of paragraphs (f)(1) and (2)(i) through the same provisions under 40 CFR, Part 60 Subpart A.
63.10(b)(2)(i)-(b)(2)(v)	General recordkeeping requirements	
63.10(d)(5)	If actions taken during a startup, shutdown and malfunction plan are consistent with the procedures in the startup, shutdown and malfunction plan, this information shall be included in a semi-annual startup, shutdown and malfunction plan report. Any time an action taken during a startup, shutdown and malfunction plan is not consistent with the startup, shutdown and malfunction plan, the source shall report actions taken within 2 working days after commencing such actions, followed by a letter 7 days after the event	
63.12(a)	These provisions do not preclude the State from adopting and enforcing any standard, limitation, etc., requiring permits, or requiring emissions reductions in excess of those specified	
63.15	Availability of information and confidentiality	
63.1(a)	Applicability: general applicability of NESHAP in this part	Affected sources are already subject to the provisions of paragraphs (a)(10)-(12) through the same provisions under 40 CFR, Part 60 Subpart A.
63.1(b)	Applicability determination for stationary sources	
63.1(e)	Title V permitting	
63.2	Definitions	

b. **40 CFR 63 Subpart A and Subpart CCCCCC—National Emission Standards for Hazardous Air Pollutants for Source Category: Gasoline Dispensing Facilities**

Pursuant to 40 CFR 63 Subpart A and Subpart CCCC, the Permittee shall comply with the following applicable General Provisions as indicated:

Table 3 to Subpart CCCCCC of Part 63—Applicability of General Provisions

General Provision Citation	*Description*	*Explanation*	*General Provision Citation*
§63.1	Applicability	Initial applicability determination; applicability after standard established; permit requirements; extensions, notifications	Yes, specific requirements given in §63.11111.
§63.1(c)(2)	Title V Permit	Requirements for obtaining a title V permit from the applicable permitting authority	Yes, §63.11111(f) of Subpart CCCCCC exempts identified area sources from the obligation to obtain title V operating permits.
§63.2	Definitions	Definitions for part 63 standards	Yes, additional definitions in §63.11132.
§63.3	Units and Abbreviations	Units and abbreviations for part 63 standards	Yes.
§63.4	Prohibited Activities and Circumvention	Prohibited activities; Circumvention, severability	Yes.
§63.5	Construction/Reconstruction	Applicability; applications; approvals	Yes, except that these notifications are not required for facilities subject to §63.11116
§63.6(a)	Compliance with Standards/Operation & Maintenance—Applicability	General Provisions apply unless compliance extension; General Provisions apply to area sources that become major	Yes.
§63.6(b)(1)-(4)	Compliance Dates for New and Reconstructed Sources	Standards apply at effective date; 3 years after effective date; upon startup; 10 years after construction or reconstruction commences for CAA section 112(f)	Yes.
§63.6(b)(5)	Notification	Must notify if commenced construction or reconstruction after proposal	Yes.
§63.6(b)(6)	[Reserved]		
§63.6(b)(7)	Compliance Dates for New and Reconstructed Area Sources That Become Major	Area sources that become major must comply with major source standards immediately upon becoming major, regardless of whether required to comply when they were an area source	No.
§63.6(c)(1)-(2)	Compliance Dates for Existing Sources	Comply according to date in this Subpart, which must be no later than 3 years after effective date; for CAA section 112(f) standards, comply within 90 days of effective date unless compliance extension	No, §63.11113 specifies the compliance dates.
§63.6(c)(3)-(4)	[Reserved]		

General Provision Citation	*Description*	*Explanation*	*General Provision Citation*
§63.6(c)(5)	Compliance Dates for Existing Area Sources That Become Major	Area sources That become major must comply with major source standards by date indicated in this Subpart or by equivalent time period (e.g., 3 years)	No.
§63.6(d)	[Reserved]		
63.6(e)(1)(i)	General duty to minimize emissions	Operate to minimize emissions at all times; information Administrator will use to determine if operation and maintenance requirements were met.	No. *See* §63.11115 for general duty requirement.
63.6(e)(1)(ii)	Requirement to correct malfunctions ASAP	Owner or operator must correct malfunctions as soon as possible.	No.
§63.6(e)(2)	[Reserved]		
§63.6(e)(3)	Startup, Shutdown, and Malfunction (SSM) Plan	Requirement for SSM plan; content of SSM plan; actions during SSM	No.
§63.6(f)(1)	Compliance Except During SSM	You must comply with emission standards at all times except during SSM	No.
§63.6(f)(2)-(3)	Methods for Determining Compliance	Compliance based on performance test, operation and maintenance plans, records, inspection	Yes.
§63.6(g)(1)-(3)	Alternative Standard	Procedures for getting an alternative standard	Yes.
§63.6(h)(1)	Compliance with Opacity/Visible Emission (VE) Standards	You must comply with opacity/VE standards at all times except during SSM	No.
§63.6(h)(2)(i)	Determining Compliance with Opacity/VE Standards	If standard does not State test method, use EPA Method 9 for opacity in Appendix A of part 60 of this chapter and EPA Method 22 for VE in Appendix A of part 60 of this chapter	No.
§63.6(h)(2)(ii)	[Reserved]		
§63.6(h)(2)(iii)	Using Previous Tests To Demonstrate Compliance With Opacity/VE Standards	Criteria for when previous opacity/VE testing can be used to show compliance with this Subpart	No.
§63.6(h)(3)	[Reserved]		
§63.6(h)(4)	Notification of Opacity/VE Observation Date	Must notify Administrator of anticipated date of observation	No.
§63.6(h)(5)(i), (iii)-(v)	Conducting Opacity/VE Observations	Dates and schedule for conducting opacity/VE observations	No.
§63.6(h)(5)(ii)	Opacity Test Duration and Averaging Times	Must have at least 3 hours of observation with 30 6-minute averages	No.
§63.6(h)(6)	Records of Conditions During Opacity/VE Observations	Must keep records available and allow Administrator to inspect	No.
§63.6(h)(7)(i)	Report Continuous Opacity Monitoring System (COMS) Monitoring Data From Performance Test	Must submit COMS data with other performance test data	No.
§63.6(h)(7)(ii)	Using COMS Instead of EPA Method 9	Can submit COMS data instead of EPA Method 9 results even if rule requires EPA Method 9 in Appendix A of part 60 of this chapter, but must notify Administrator before performance test	No.

General Provision Citation	*Description*	*Explanation*	*General Provision Citation*
§63.6(h)(7)(iii)	Averaging Time for COMS During Performance Test	To determine compliance, must reduce COMS data to 6-minute averages	No.
§63.6(h)(7)(iv)	COMS Requirements	Owner/operator must demonstrate that COMS performance evaluations are conducted according to §63.8(e); COMS are properly maintained and operated according to §63.8(c) and data quality as §63.8(d)	No.
§63.6(h)(7)(v)	Determining Compliance with Opacity/VE Standards	COMS is probable but not conclusive evidence of compliance with opacity standard, even if EPA Method 9 observation shows otherwise. Requirements for COMS to be probable evidence-proper maintenance, meeting Performance Specification 1 in Appendix B of part 60 of this chapter, and data have not been altered	No.
§63.6(h)(8)	Determining Compliance with Opacity/VE Standards	Administrator will use all COMS, EPA Method 9 (in appendix A of part 60 of this chapter), and EPA Method 22 (in Appendix A of part 60 of this chapter) results, as well as information about operation and maintenance to determine compliance	No.
§63.6(h)(9)	Adjusted Opacity Standard	Procedures for Administrator to adjust an opacity standard	No.
§63.6(i)(1)-(14)	Compliance Extension	Procedures and criteria for Administrator to grant compliance extension	Yes.
§63.6(j)	Presidential Compliance Exemption	President may exempt any source from requirement to comply with this Subpart	Yes.
§63.7(a)(2)	Performance Test Dates	Dates for conducting initial performance testing; must conduct 180 days after compliance date	Yes.
§63.7(a)(3)	CAA Section 114 Authority	Administrator may require a performance test under CAA Section 114 at any time	Yes.
§63.7(b)(1)	Notification of Performance Test	Must notify Administrator 60 days before the test	Yes.
§63.7(b)(2)	Notification of Re-scheduling	If have to reschedule performance test, must notify Administrator of rescheduled date as soon as practicable and without delay	Yes.
§63.7(c)	Quality Assurance (QA)/Test Plan	Requirement to submit site-specific test plan 60 days before the test or on date Administrator agrees with; test plan approval procedures; performance audit requirements; internal and external QA procedures for testing	Yes.
§63.7(d)	Testing Facilities	Requirements for testing facilities	Yes.
63.7(e)(1)	Conditions for Conducting Performance Tests	Performance test must be conducted under representative conditions	No, §63.11120(c) specifies conditions for conducting performance tests.
§63.7(e)(2)	Conditions for Conducting Performance Tests	Must conduct according to this Subpart and EPA test methods unless Administrator approves alternative	Yes.

General Provision Citation	*Description*	*Explanation*	*General Provision Citation*
§63.7(e)(3)	Test Run Duration	Must have three test runs of at least 1 hour each; compliance is based on arithmetic mean of three runs; conditions when data from an additional test run can be used	Yes.
§63.7(f)	Alternative Test Method	Procedures by which Administrator can grant approval to use an intermediate or major change, or alternative to a test method	Yes.
§63.7(g)	Performance Test Data Analysis	Must include raw data in performance test report; must submit performance test data 60 days after end of test with the Notification of Compliance Status; keep data for 5 years	Yes.
§63.7(h)	Waiver of Tests	Procedures for Administrator to waive performance test	Yes.
§63.8(a)(1)	Applicability of Monitoring Requirements	Subject to all monitoring requirements in standard	Yes.
§63.8(a)(2)	Performance Specifications	Performance Specifications in Appendix B of 40 CFR part 60 apply	Yes.
§63.8(a)(3)	[Reserved]		
§63.8(a)(4)	Monitoring of Flares	Monitoring requirements for flares in §63.11 apply	Yes.
§63.8(b)(1)	Monitoring	Must conduct monitoring according to standard unless Administrator approves alternative	Yes.
§63.8(b)(2)-(3)	Multiple Effluents and Multiple Monitoring Systems	Specific requirements for installing monitoring systems; must install on each affected source or after combined with another affected source before it is released to the atmosphere provided the monitoring is sufficient to demonstrate compliance with the standard; if more than one monitoring system on an emission point, must report all monitoring system results, unless one monitoring system is a backup	No.
§63.8(c)(1)	Monitoring System Operation and Maintenance	Maintain monitoring system in a manner consistent with good air pollution control practices	No.
§63.8(c)(1)(i)-(iii)	Operation and Maintenance of Continuous Monitoring Systems (CMS)	Must maintain and operate each CMS as specified in §63.6(e)(1); must keep parts for routine repairs readily available; must develop a written SSM plan for CMS, as specified in §63.6(e)(3)	No.
§63.8(c)(2)-(8)	CMS Requirements	Must install to get representative emission or parameter measurements; must verify operational status before or at performance test	No.
§63.8(d)	CMS Quality Control	Requirements for CMS quality control, including calibration, etc.; must keep quality control plan on record for 5 years; keep old versions for 5 years after revisions	No.
§63.8(e)	CMS Performance Evaluation	Notification, performance evaluation test	No.

General Provision Citation	Description	Explanation	General Provision Citation
		plan, reports	
§63.8(f)(1)-(5)	Alternative Monitoring Method	Procedures for Administrator to approve alternative monitoring	No.
§63.8(f)(6)	Alternative to Relative Accuracy Test	Procedures for Administrator to approve alternative relative accuracy tests for continuous emissions monitoring system (CEMS)	No.
§63.8(g)	Data Reduction	COMS 6-minute averages calculated over at least 36 evenly spaced data points; CEMS 1 hour averages computed over at least 4 equally spaced data points; data that cannot be used in average	No.
§63.9(a)	Notification Requirements	Applicability and State delegation	Yes.
§63.9(b)(1)-(2), (4)-(5)	Initial Notifications	Submit notification within 120 days after effective date; notification of intent to construct/reconstruct, notification of commencement of construction/reconstruction, notification of startup; contents of each	Yes.
§63.9(c)	Request for Compliance Extension	Can request if cannot comply by date or if installed best available control technology or lowest achievable emission rate	Yes.
§63.9(d)	Notification of Special Compliance Requirements for New Sources	For sources that commence construction between proposal and promulgation and want to comply 3 years after effective date	Yes.
§63.9(e)	Notification of Performance Test	Notify Administrator 60 days prior	Yes.
§63.9(f)	Notification of VE/Opacity Test	Notify Administrator 30 days prior	No.
§63.9(g)	Additional Notifications when Using CMS	Notification of performance evaluation; notification about use of COMS data; notification that exceeded criterion for relative accuracy alternative	Yes, however, there are no opacity standards.
§63.9(h)(1)-(6)	Notification of Compliance Status	Contents due 60 days after end of performance test or other compliance demonstration, except for opacity/VE, which are due 30 days after; when to submit to Federal vs. State authority	Yes, however, there are no opacity standards.
§63.9(i)	Adjustment of Submittal Deadlines	Procedures for Administrator to approve change when notifications must be submitted	Yes.
§63.9(j)	Change in Previous Information	Must submit within 15 days after the change	Yes.
§63.10(a)	Recordkeeping/Reporting	Applies to all, unless compliance extension; when to submit to Federal vs. State authority; procedures for owners of more than one source	Yes.
§63.10(b)(1)	Recordkeeping/Reporting	General requirements; keep all records readily available; keep for 5 years	Yes.
§63.10(b)(2)(i)	Records related to SSM	Recordkeeping of occurrence and duration of startups and shutdowns	No.

General Provision Citation	*Description*	*Explanation*	*General Provision Citation*
§63.10(b)(2)(ii)	Records related to SSM	Recordkeeping of malfunctions	No. *See* §63.11125(d) for recordkeeping of (1) occurrence and duration and (2) actions taken during malfunction.
§63.10(b)(2)(iii)	Maintenance records	Recordkeeping of maintenance on air pollution control and monitoring equipment	Yes.
§63.10(b)(2)(iv)	Records Related to SSM	Actions taken to minimize emissions during SSM	No.
§63.10(b)(2)(v)	Records Related to SSM	Actions taken to minimize emissions during SSM	No.
§63.10(b)(2)(vi)-(xi)	CMS Records	Malfunctions, inoperative, out-of-control periods	No.
§63.10(b)(2)(xii)	Records	Records when under waiver	Yes.
§63.10(b)(2)(xiii)	Records	Records when using alternative to relative accuracy test	Yes.
§63.10(b)(2)(xiv)	Records	All documentation supporting Initial Notification and Notification of Compliance Status	Yes.
§63.10(b)(3)	Records	Applicability determinations	Yes.
§63.10(c)	Records	Additional records for CMS	No.
§63.10(d)(1)	General Reporting Requirements	Requirement to report	Yes.
§63.10(d)(2)	Report of Performance Test Results	When to submit to Federal or State authority	Yes.
§63.10(d)(3)	Reporting Opacity or VE Observations	What to report and when	No.
§63.10(d)(4)	Progress Reports	Must submit progress reports on schedule if under compliance extension	Yes.
§63.10(d)(5)	SSM Reports	Contents and submission	No. *See* §63.11126(b) for malfunction reporting requirements.
§63.10(e)(1)-(2)	Additional CMS Reports	Must report results for each CEMS on a unit; written copy of CMS performance evaluation; two-three copies of COMS performance evaluation	No.
§63.10(e)(3)(i)-(iii)	Reports	Schedule for reporting excess emissions	No.
§63.10(e)(3)(iv)-(v)	Excess Emissions Reports	Requirement to revert to quarterly submission if there is an excess emissions and parameter monitor exceedances (now defined as deviations); provision to request semiannual reporting after compliance for 1 year; submit report by 30th day following end of quarter or calendar half; if there has	No.

General Provision Citation	*Description*	*Explanation*	*General Provision Citation*
		not been an exceedance or excess emissions (now defined as deviations), report contents in a statement that there have been no deviations; must submit report containing all of the information in §§63.8(c)(7)-(8) and 63.10(c)(5)-(13)	
§63.10(e)(3)(iv)-(v)	Excess Emissions Reports	Requirement to revert to quarterly submission if there is an excess emissions and parameter monitor exceedances (now defined as deviations); provision to request semiannual reporting after compliance for 1 year; submit report by 30th day following end of quarter or calendar half; if there has not been an exceedance or excess emissions (now defined as deviations), report contents in a statement that there have been no deviations; must submit report containing all of the information in §§63.8(c)(7)-(8) and 63.10(c)(5)-(13)	No, §63.11130(K) specifies excess emission events for this Subpart.
§63.10(e)(3)(vi)-(viii)	Excess Emissions Report and Summary Report	Requirements for reporting excess emissions for CMS; requires all of the information in §§63.10(c)(5)-(13) and 63.8(c)(7)-(8)	No.
§63.10(e)(4)	Reporting COMS Data	Must submit COMS data with performance test data	No.
§63.10(f)	Waiver for Recordkeeping/Reporting	Procedures for Administrator to waive	Yes.
§63.11(b)	Flares	Requirements for flares	No.
§63.12	Delegation	State authority to enforce standards	Yes.
§63.13	Addresses	Addresses where reports, notifications, and requests are sent	Yes.
§63.14	Incorporations by Reference	Test methods incorporated by reference	Yes.
§63.15	Availability of Information	Public and confidential information	Yes.

Section 8 - State Only Requirements

1. Permitted Emissions for Fees

The annual emissions from the ADS Zion landfill portion of the source for purposes of "Duties to Pay Fees" of Condition 2.3(e), not considering insignificant activities as addressed by Section 6, shall not exceed the following limitations. The overall fee emissions shall be determined by adding emissions from all ADS Zion landfill emission units. Compliance with these limits shall be determined on a calendar year basis. The Permittee shall maintain records with supporting calculations of how the annual emissions for fee purposes were calculated. This Condition is set for the purpose of establishing fees and is not federally enforceable. See Section 39.5(18) of the Act.

Pollutant		*Tons/Year*
Volatile Organic Material	(VOM)	8.0
Sulfur Dioxide	(SO_2)	58.0
Particulate Matter	(PM)	37.0
Nitrogen Oxides	(NO_x)	16.0
HAP, not included in VOM or PM	(HAP)	2.0
Total		121.0

Attachment 1 - Acronyms and Abbreviations

acfm	Actual cubic feet per minute
ACMA	Alternative Compliance Market Account
Act	Illinois Environmental Protection Act [415 ILCS 5/1 et seq.]
ADS Zion Landfill	Advanced Disposal Services Zion Landfill
AP-42	Compilation of Air Pollutant Emission Factors, Volume 1, Stationary Point and Other Sources (and Supplements A through F), USEPA, Office of Air Quality Planning and Standards, Research Triangle Park, NC 27711
ATU	Allotment trading unit
BACT	Best Available Control Technology
BAT	Best Available Technology
Btu	British Thermal Units
CAA	Clean Air Act [42 U.S.C. Section 7401 et seq.]
CAAPP	Clean Air Act Permit Program
CAIR	Clean Air Interstate Rule
CAM	Compliance Assurance Monitoring
CEMS	Continuous Emission Monitoring System
CFR	Code of Federal Regulations
CISWI	Commercial Industrial Solid Waste Incinerator
CO	Carbon monoxide
CO_2	Carbon dioxide
COMS	Continuous Opacity Monitoring System
CPMS	Continuous Parameter Monitoring System
dscf	Dry standard cubic foot
dscm	Dry standard cubic meter
ERMS	Emissions Reduction Market System
°F	Degrees Fahrenheit
GHG	Green house gas
GACT	Generally Acceptable Control Technology
gr	Grains
HAP	Hazardous air pollutant
Hg	Mercury
HMIWI	Hospital medical infectious waste incinerator
hp	Horsepower
hr	Hour
H_2S	Hydrogen sulfide
I.D. No.	Identification number of source, assigned by IEPA
IAC	Illinois Administrative Code
ILCS	Illinois Compiled Statutes
IEPA	Illinois Environmental Protection Agency
kw	Kilowatts
LAER	Lowest Achievable Emission Rate

lbs	Pound
m	Meter
MACT	Maximum Achievable Control Technology
M	Thousand
MM	Million
mos	Month
MSDS	Material Safety Data Sheet
MSSCAM	Major Stationary Sources Construction and Modification (Non-attainment New Source Review)
MW	Megawatts
NESHAP	National Emission Standards for Hazardous Air Pollutants
NO_x	Nitrogen oxides
NSPS	New Source Performance Standards
NSR	New Source Review
PB	Lead
PEMS	Predictive Emissions Monitoring System
PM	Particulate matter
PM_{10}	Particulate matter with an aerodynamic diameter less than or equal to a nominal 10 microns as measured by applicable test or monitoring methods
$PM_{2.5}$	Particulate matter with an aerodynamic diameter less than or equal to a nominal 2.5 microns as measured by applicable test or monitoring methods
ppm	Parts per million
ppmv	Parts per million by volume
ppmw	Parts per million by weight
PSD	Prevention of Significant Deterioration
PSEU	Pollutant-Specific Emission Unit
psia	Pounds per square inch absolute
PTE	Potential to emit
RACT	Reasonable Available Control Technology
RMP	Risk Management Plan
scf	Standard cubic feet
SCR	Selective catalytic reduction
SIP	State Implementation Plan
SO_2	Sulfur dioxide
T1	Title I - identifies Title I conditions that have been carried over from an existing permit
T1N	Title I New - identifies Title I conditions that are being established in this permit
T1R	Title I Revised - identifies Title I conditions that have been carried over from an existing permit and subsequently revised in this permit
TRS	Total Reduced Sulfur
USEPA	United States Environmental Protection Agency
VOM	Volatile organic material
w.c.	Water Column

Attachment 2 - Contact and Reporting Addresses

IEPA Compliance Section	Illinois EPA, Bureau of Air Compliance & Enforcement Section (MC 40) 1021 North Grand Avenue East P.O. Box 19276 Springfield, Illinois 62794-9276 Phone No.: 217/782-2113
IEPA Stack Test Specialist	Illinois EPA, Bureau of Air Compliance Section Source Monitoring - Third Floor 9511 Harrison Street Des Plaines, Illinois 60016 Phone No.: 847/294-4000
IEPA Air Quality Planning Section	Illinois EPA, Bureau of Air Air Quality Planning Section (MC 39) 1021 North Grand Avenue East P.O. Box 19276 Springfield, Illinois 62794-9276 Phone No.: 217/782-2113
IEPA Air Regional Field Operations Regional Office #1	Illinois EPA, Bureau of Air Regional Office #1 9511 Harrison Street Des Plaines, Illinois 60016 Phone No.: 847/294-4000
IEPA Permit Section	Illinois EPA, Bureau of Air Permit Section (MC 11) 1021 North Grand Avenue East P.O. Box 19506 Springfield, Illinois 62794-9506 Phone No.: 217/785-1705
USEPA Region 5 - Air Branch	USEPA (AR - 17J) Air and Radiation Division 77 West Jackson Boulevard Chicago, IL 60604 Phone No.: 312/353-2000

Attachment 3 - Example Certification by a Responsible Official

SIGNATURE BLOCK	
NOTE: THIS CERTIFICATION MUST BE SIGNED BY A RESPONSIBLE OFFICIAL. APPLICATIONS WITHOUT A SIGNED CERTIFICATION WILL BE DEEMED AS INCOMPLETE.	
I CERTIFY UNDER PENALTY OF LAW THAT, BASED ON INFORMATION AND BELIEF FORMED AFTER REASONABLE INQUIRY, THE STATEMENTS AND INFORMATION CONTAINED IN THIS APPLICATION ARE TRUE, ACCURATE AND COMPLETE. ANY PERSON WHO KNOWINGLY MAKES A FALSE, FICTITIOUS, OR FRAUDULENT MATERIAL STATEMENT, ORALLY OR IN WRITING, TO THE ILLINOIS EPA COMMITS A CLASS 4 FELONY. A SECOND OR SUBSEQUENT OFFENSE AFTER CONVICTION IS A CLASS 3 FELONY. (415 ILCS 5/44(H))	
AUTHORIZED SIGNATURE:	
BY: ______________________	______________________
AUTHORIZED SIGNATURE	TITLE OF SIGNATORY
______________________	______ / ______ / ______
TYPED OR PRINTED NAME OF SIGNATORY	DATE

ATTACHMENT 11
Revised Appendix Q

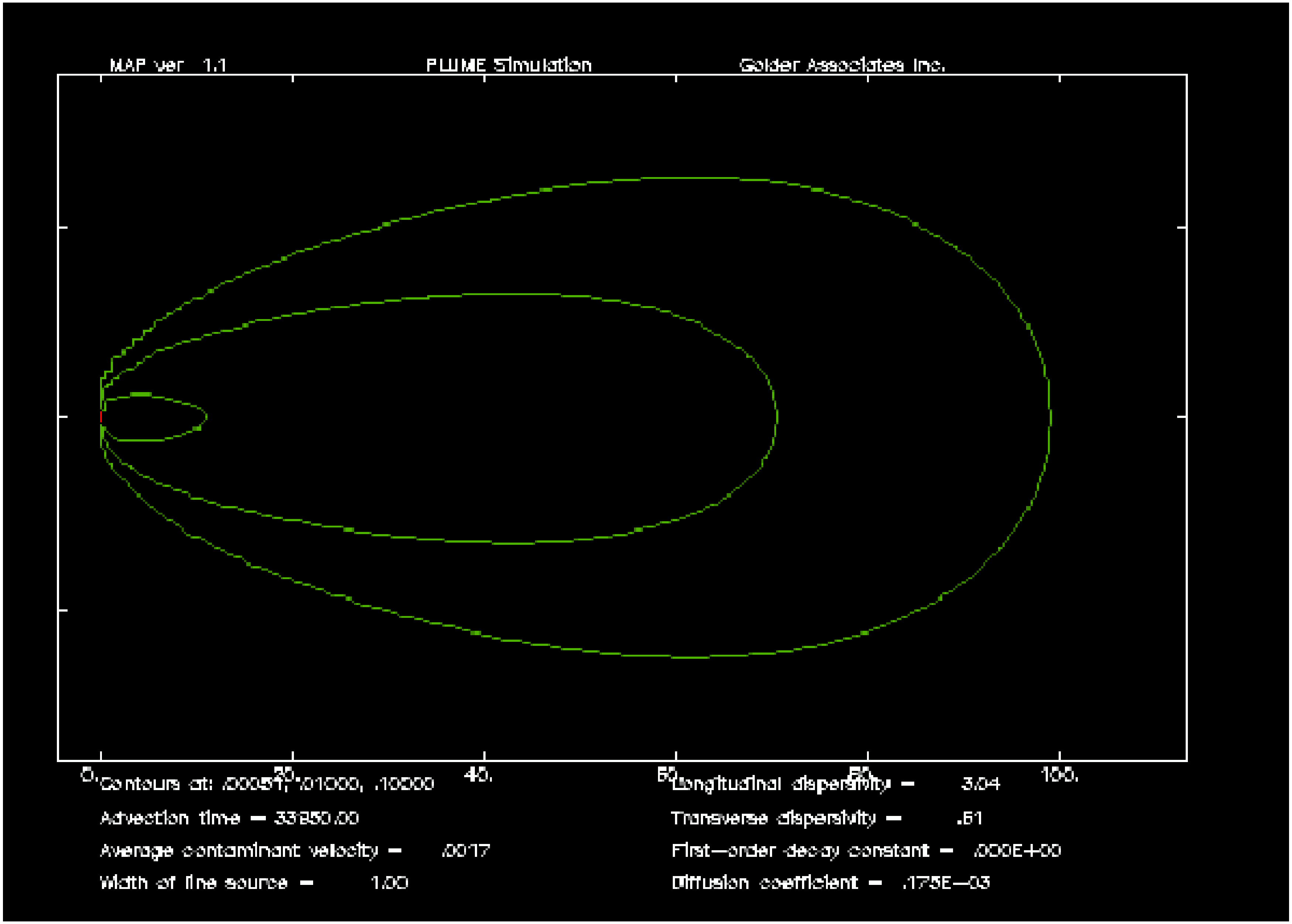
APTIM

APPENDIX Q

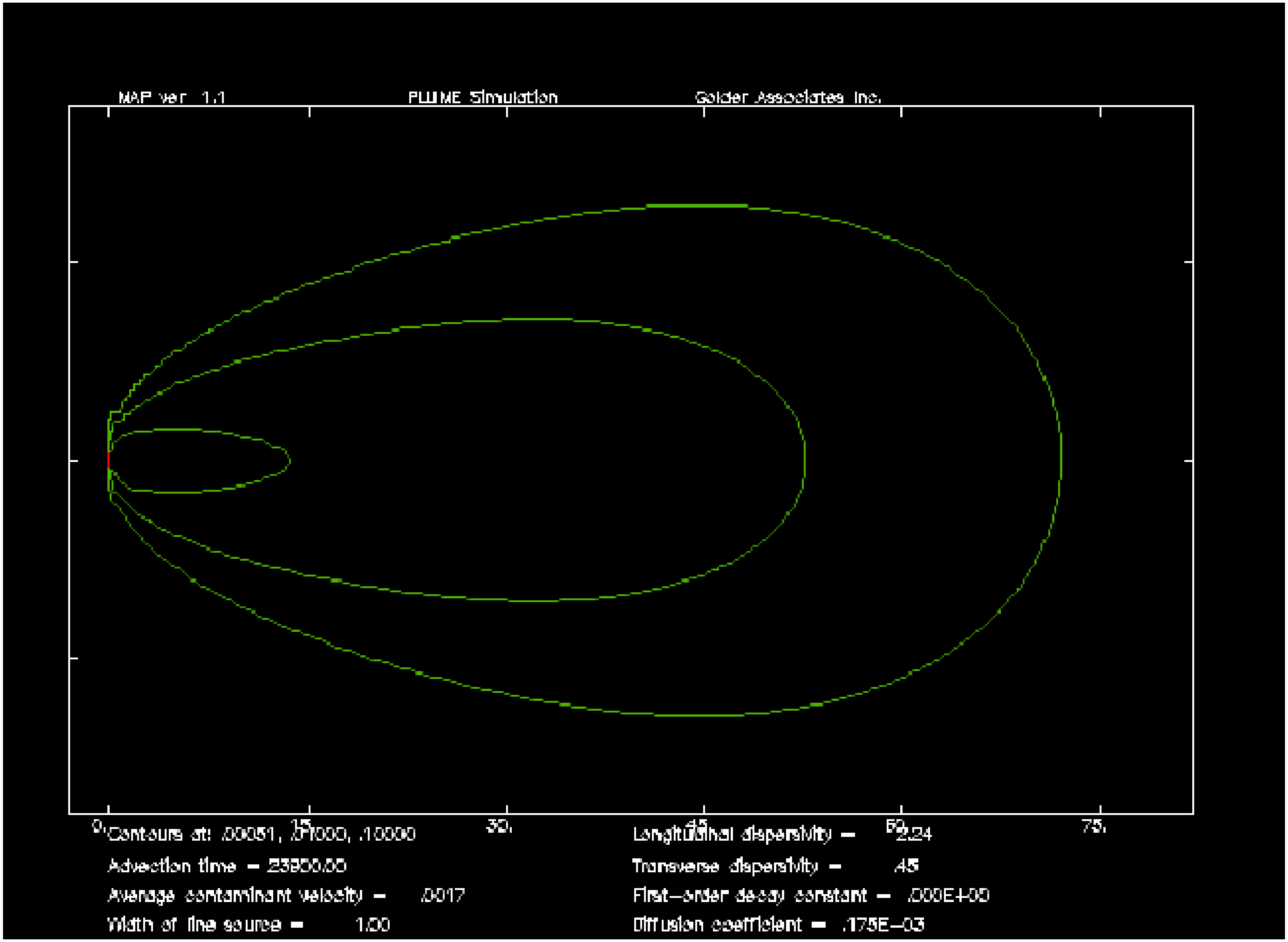
ENVIRONMENTAL MONITORING

APPENDIX Q.1
Output PLUME Models

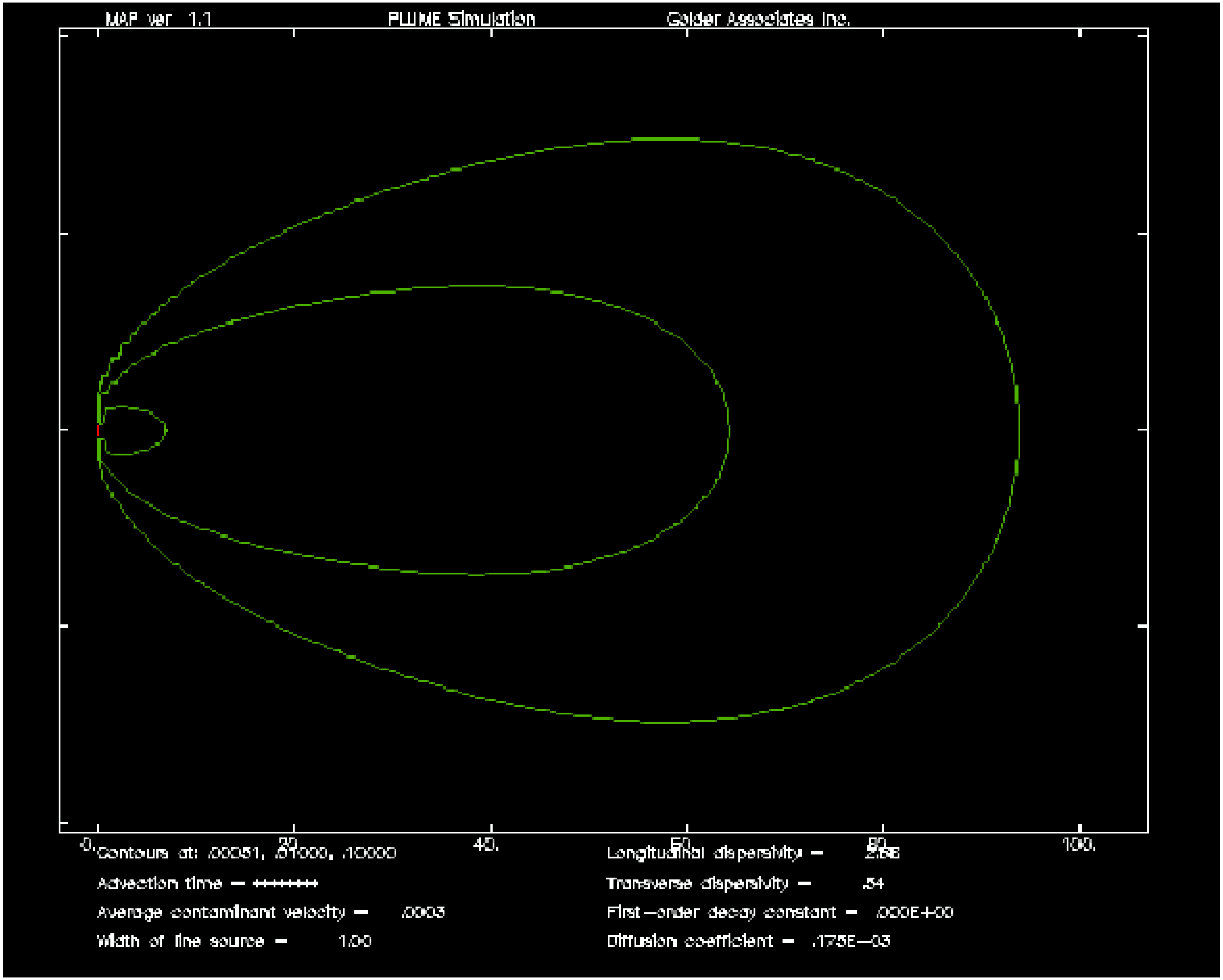
NORTHWEST PLUME



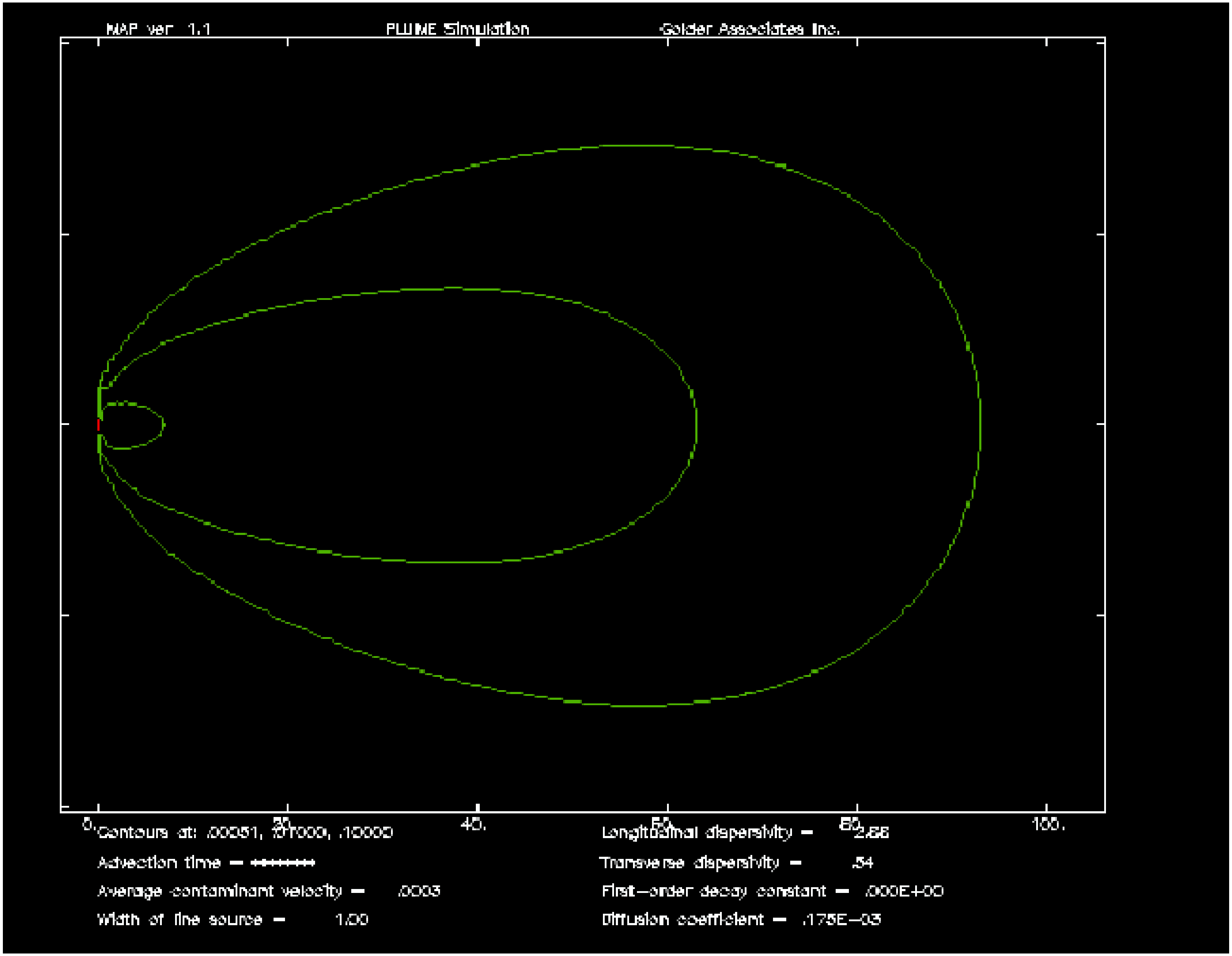
NORTH PLUME


MAP ver 1.1
PLUME Simulation
Golder Associates Inc.
0
15
30.
45
60
75.
Contours at: .00051, .01000, .10000
Advection time = 23500.00
Average contaminant velocity = .0017
Width of line source = 1.00
Longitudinal dispersivity = 2.24
Transverse dispersivity = .45
First-order decay constant = .000E+00
Diffusion coefficient = .175E-03

NORTHEAST PLUME



SOUTHEAST PLUME



APPENDIX Q.2
Existing Zion Landfill Applicable Groundwater Quality Standards (AGQSs)

0978020002 - Lake County
Advanced Disposal Services Zion Landfill
Permit No. 1995-343-LFM
Modification No. 139
Log No. 2018-275

ATTACHMENT 1

SHALLOW DRIFT AQUIFER

(Groundwater - Quarterly)

FIELD PARAMETERS	STORETS	MAPC/AGQS
pH	00400	7.13-10.24
Specific Conductance	00094	520.5
Temperature of Water Sample (°F)	00011	--------
Depth to Water (ft. below land surface)	72019	--------
Depth to Water (ft. below measuring point)	72109	--------
Elevation of Measuring Point (Top of casing ft. MSL)	72110	--------
Elevation of Groundwater Surface (ft. MSL)	71993	--------
Elevation of Bottom of Well (ft. MSL)	72020	--------
Ammonia (as Nitrogen; Dissolved) mg/L	00608	0.60
Arsenic (Dissolved) ug/L	01000	6.2
Boron (Dissolved) ug/L	01020	1,985
Cadmium (Dissolved) ug/L	01025	10.0
Chloride (Dissolved) mg/L	00941	18.0
Cyanide (Total) mg/L	00720	10.0
Iron (Dissolved) ug/L	01046	992.0
Lead (Dissolved) ug/L	01049	20.0
Manganese (Dissolved) ug/L	01056	63.0
Mercury (Dissolved) ug/L	71890	0.2
Nitrate (as Nitrogen, Dissolved) mg/L	00618	0.89
Phenols (Total Recoverable) ug/L	32730	63.9
Sulfate (Dissolved) mg/L	00946	166.8
Total Dissolved Solids (TDS, 180°C; Dissolved) mg/L	70300	594.4
Total Organic Carbon (TOC; Total) mg/L	00680	6.3
Zinc (Dissolved) ug/L	01090	32.0

(Groundwater - Annual)

PARAMETERS (ug/L)	STORETS	MAPC/AGQS
UNFILTERED (totals)		
Acetone	81552	100.0
Acrolein	34210	25.0
Acrylonitrile	34215	200.0

Attachment 1 (continued)
(Groundwater - Annual) (cont.)

PARAMETERS (ug/L)	STORETS	MAPC/AGQS
UNFILTERED (totals)		
Alachlor	77825	2.0
Aldicarb	39053	3.0
Aldrin	39330	1.0
Aluminum	01105	173078.4
Ammonia (as N) (mg/L)	00610	0.60
Antimony	01097	6.0
Arsenic	01002	7.0
Atrazine	39033	3.0
Barium	01007	248.0
Benzene	34030	5.0
Benzo(a)Pyrene	34247	0.2
Benzoic Acid	77247	100.0
Benzyl Alcohol	77147	10.0
Beryllium	01012	4.0
Beta-BHC	39338	0.05
Bis (chloromethyl) ether	34268	10.0
BOD (mg/L)	00310	9.0
Boron	01022	860.0
Bromobenzene	81555	5.0
Bromochloromethane (chlorobromomethane)	77297	1.0
Bromodichloromethane	32101	5.0
Bromoform (Tribromomethane)	32104	10.0
Bromomethane (Methyl Bromide)	34413	10.0
n-Butylbenzene	77342	5.0
sec-Butylbenzene	77350	5.0
tert-Butylbenzene	77353	5.0
Cadmium	01027	10.0
Calcium (mg/L)	00916	300.0
Carbofuran	81405	40.0
Carbon Disulfide	77041	5.0
Carbon Tetrachloride	32102	5.0
Chemical Oxygen Demand (COD) (mg/L)	00335	92.0
Chlordane	39350	2.0
Chloride (mg/L)	00940	12.0
Chlorobenzene	34301	5.0
Chloroethane (Ethyl Chloride)	34311	10.0
Chloroform (Trichloromethane)	32106	5.0
Chloromethane (Methyl Chloride)	34418	10.0
o-Chlorotoluene	77275	1.0

Attachment 1 (continued)
(Groundwater - Annual) (cont.)

PARAMETERS (ug/L)	STORETS	MAPC/AGQS
UNFILTERED (totals)		
p-Chlorotoluene	77277	5.0
Chromium	01034	270.0
Chlorodibromomethane (Dibromochloromethane)	32105	5.0
Cobalt	01037	100.0
Copper	01042	40.0
p-Cresol	77146	10.0
Dalapon	38432	20.0
DDT	39370	10.0
Dibromomethane (Methylene Bromide)	77596	10.0
m-Dichlorobenzene (1,3 Dichlorobenzene)	34566	5.0
o-Dichlorobenzene (1,2 Dichlorobenzene)	34536	10.0
p-Dichlorobenzene (1,4 Dichlorobenzene)	34571	5.0
Dichlorodifluoromethane	34668	5.0
Dichloromethane (Methylene Chloride)	34423	5.0
Dieldrin	39380	10.0
Diethyl Phthalate	34336	10.0
Dimethyl Phthlate	34341	10.0
Di-N-Butyl Phthlate	39110	10.0
Dinoseb (DNBP)	81287	1.0
Endothall	38926	50.0
Endrin	39390	0.2
Di(2-Ethylhexyl)Phthalate	39100	6.0
Ethanol	77004	1000.0
Ethylbenzene	78113	5.0
Ethylene Dibromide (EDB)(1,2-Dibromo ethane)	77651	0.05
Fluoride (mg/L)	00951	1.86
Heptachlor	39410	0.4
Heptachlor Epoxide	39420	0.2
Hexachlorobutadiene	39702	10.0
Hexachlorcyclopentadiene	34386	50.0
Iodomethane (Methyl Iodide)	77424	10.0
Iron	01045	26058.9
Isophorone	34408	10.0
Isopropylbenzene	77223	5.0
p-Isopropyltoluene	77356	5.0
Lead	01051	136.0
Lindane	39782	0.2
Magnesium (mg/L)	00927	140.0
Manganese	01055	1732.5

Attachment 1 (continued)
(Groundwater - Annual) (cont.)

PARAMETERS (ug/L)	STORETS	MAPC/AGQS
UNFILTERED (totals)		
Mercury	71900	0.2
Methoxyclor	39480	40.0
Naphthalene	34696	5.0
Nickel	01067	119.0
Nitrate-Nitrogen (mg/L)	00620	0.50
Oil(Hexane-Soluble or Equivalent) (mg/L)	00552	14.0
Parathion	39540	10.0
Pentachlorophenol	39032	1.0
Phosphorous	00665	1590.0
Picloram	39720	50.0
Polychlorinated Biphenyls	39516	0.5
Potassium (mg/L)	00937	11.0
n-Butyl alcohol (1-Butanol)	45265	5000.0
n-Propanol	77018	1000.0
n-Propylbenzene	77224	5.0
Selenium	01147	5.0
Silver	01077	50.0
Simazine	39055	2.0
Sodium (mg/L)	00929	110.0
Styrene	77128	10.0
Sulfate (mg/L)	00945	90.0
Tetrachloroethylene (Perchloroethylene)	34475	5.0
Tetrahydrofuran	81607	20.0
Thallium	01059	9.2
Toluene	34010	5.0
Toxaphene	39400	3.0
Trichloroethylene (Trichloroethene)	39180	5.0
Trichlorofluoromethane	34488	5.0
Vanadium	01087	75.0
Vinyl Chloride	39175	2.0
Vinyl Acetate	77057	10.0
Xylenes	81551	10.0
m-Xylene	77134	10.0
o-Xylene	77135	10.0
p-Xylene	77133	10.0
Zinc	01092	144.5
1,1,1,2-Tetrachloroethane	77562	5.0
1,1,1-Trichloroethane (Methylchloroform)	34506	5.0

Attachment 1 (continued)
(Groundwater - Annual) (cont.)

PARAMETERS (ug/L)	STORETS	MAPC/AGQS
UNFILTERED (totals)		
1,1,2,2-Tetrachloroethane	34516	10.0
1,1,2-Trichloroethane	34511	5.0
1,1-Dichloroethane	34496	5.0
1,1-Dichloroethylene	34501	5.0
1,1-Dichloropropene	77168	5.0
1,2,3-Trichlorobenzene	77613	5.0
1,2,3-Trichloropropane	77443	15.0
1,2,4-Trichlorobenzene	34551	10.0
1,2,4-Trimethylbenzene	77222	5.0
1,2-Dibromo-3-Chloropropane (DBCP)	38760	25.0
cis-1,2-Dichloroethylene	77093	5.0
trans-1,2-Dichloroethylene	34546	1.0
1,2-Dichloroethane	34531	5.0
1,2-Dichloropropane (Propylene Dichloride)	34541	5.0
1,3,5-Trimethylbenzene	77226	5.0
1,3-Dichloropropane	77173	5.0
1,3-Dichloropropene	34561	5.0
cis-1,3-Dichloropropene	34704	10.0
trans-1,3-Dichloropropene	34699	10.0
trans-1,4-Dichloro-2-Butene	49263	5.0
2-chloroethyl vinyl ether	34576	8.8
2,2-Dichloropropane	77170	15.0
2,4,5-TP (Silvex)	39760	2.0
2,4-Dichlorophenoxyacetic Acid (2,4-D)	39730	10.0
2-Butanone(Methyl Ethyl Ketone)	81595	10.0
2-Hexanone (Methyl Butyl Ketone)	77103	50.0
4-Methyl-2-Pentanone (Methyl Isobutyl Ketone)	78133	50.0
2-Propanol	81310	1000.0

INTRATILL SORTED SEDIMENTS
(Groundwater - Quarterly)

FIELD PARAMETERS	STORETS	MAPC	AGQS
pH	00400	6.67-8.64	6.67-8.64
Specific Conductance	00094		
Temperature of Water Sample (°F)	00011	----	----
Depth to Water (ft. below land surface)	72019	----	----

Attachment 1 (continued)
(Groundwater - Annual) (cont.)

PARAMETERS (ug/L)	STORETS	MAPC	AGQS
Acenaphthene	34205	420	420
Anthracene	34220	2,100	2,100
Benzo(a)anthracene	34526	0.13	0.13
Benzo(b)fluoranthene	34230	0.18	0.18
Benzo(k)fluoranthene	34242	0.17	0.17
Chrysene	34320	12	12
Dibenzo(a,h)anthracene	34556	0.3	0.3
Dicamba	82052	210	210
Fluoranthene	34376	280	280
Fluorene	34381	280	280
Indeno(1,2,3-cd)pyrene	34403	0.43	0.43
MCPP (Mecoprop)	38491	7	7
2-Methylnaphthalene	77416	28	28
2-Methylphenol (o-Cresol)	77152	350	350
P-Dioxane (1,4-Dioxane)	81582	7.7	7.7
Pyrene	34469	210	210
alpha-BHC	39337	0.11	0.11
Perchlorate	61209	4.9	4.9
MTBE	46491	70	70

Attachement 2

Site Name: ADS Zion Landfill
Site Number: 0978020002

IEPA Permit No: 1995-343-LFM
Permit Log No: 2018-275

List G1 & G2 Intrawell Value Table (Shallow Drift Aquifer)

Parameter	STORET	Monitoring Wells								
		C129	G131	G132	G160	G161	G162	G163	G164	G165
Field Parameters										
pH	00400	--	--	--	--	--	--	--	6.57 - 7.86	--
Specific Conductance (umhos/cm)	00094	1,194	295.2	--	722.2	913.0	1,035.4	861.2	1,463.4	833.0
Indicator Parameters										
Boron (Dissolved) ug/L	01020	--	2,111.0	1,879.0	1,446.8	709.7	601.1	673.6	660.0	574.0
Manganese (Dissolved) ug/L	01056	--	--	--	--	--	--	--	671.7	197.0
Sulfate (Dissolved) mg/L	00946	728.8	210.0	--	261.5	331.4	346.4	348.7	537.5	286.8
Total Dissolved Solids (TDS) mg/L	70300	742.9	328.4	--	562.2	683.3	773.6	612.2	1,111.5	575.0
Unfiltered Parameters										
Boron (Total) ug/L	01022	925.0	2,007.0	2,366.0	924.0	800.0	681.0	811.0	757.0	707.0
Sulfate (Total) mg/L	00945	580.9	28.2	33.3	230.0	370.7	300.0	301.1	300.0	242.4

Parameter	STORET	Monitoring Wells								
		G166	G167	G176	G177	G178	G179	G180	G181	G182
Field Parameters										
pH	00400	--	--	--	--	--	--	--	--	--
Specific Conductance (umhos/cm)	00094	1,690.0	638.0	464.0	398.7	395.2	576.2	318.2	366.9	676.9
Indicator Parameters										
Boron (Dissolved) ug/L	01020	914.0	684.0	727.0	701.8	3,771.5	691.8	1,760.5	1,000.0	2,950.3
Manganese (Dissolved) ug/L	01056	--	--	--	--	--	--	--	--	--
Sulfate (Dissolved) mg/L	00946	322.5	69.5	50.1	30.0	22.3	73.3	140.0	21.0	122.8
Total Dissolved Solids (TDS) mg/L	70300	1,063.3	501.2	301.8	335.9	272.2	362.9	262.2	284.4	472.8
Unfiltered Parameters										
Boron (Total) ug/L	01022	825.0	751.0	769.0	860.0	2,871.0	854.0	1,061.0	1,379.0	1,200.0
Sulfate (Total) mg/L	00945	354.5	112.3	49.8	34.5	50.7	41.1	31.7	20.7	52.0

Attachement 2 - Continued

Site Name: Veolia ES Zion Landfill
Site Number: 0978020002

IEPA Permit No: 1995-343-LFM
Permit Log No: 2018-275

List G1 & G2 Intrawell Value Table (Shallow Drift Aquifer) - Continued

Parameter	STORET	Monitoring Wells								
		G183	G184	G185	G186	G187	G188	G191	G193	R124
Field Parameters										
pH	00400	--	--	--	--	--	--	--	--	--
Specific Conductance (umhos/cm)	00094	466.0	315.3	333.2	489.0	276.0	369.7	501.0	257.0	789.7
Indicator Parameters										
Boron (Dissolved) ug/L	01020	712.2	1,246.6	740.7	582.9	830.5	641.5	727.0	879.7	750.1
Manganese (Dissolved) ug/L	01056	--	--	--	--	--	--	--	--	--
Sulfate (Dissolved) mg/L	00946	55.2	22.2	10.7	93.2	14.0	9.7	64.6	21.6	291.5
Total Dissolved Solids (TDS) mg/L	70300	240.0	314.4	253.7	336.1	252.2	312.2	391.4	843.6	568.6
Unfiltered Parameters										
Boron (Total) ug/L	01022	790.0	3,359.0	814.0	--	--	--	608.0	1,735.0	909.0
Sulfate (Total) mg/L	00945	69.8	42.8	44.8	--	--	--	59.0	28.8	286.1

Parameter	STORET	Monitoring Wells					
		R126	R128	G132	R133	T001	T002
Field Parameters							
pH	00400	--	--	--	--	--	--
Specific Conductance (umhos/cm)	00094	2,554.9	466.0	278.7	354.9	488.0	488.0
Indicator Parameters							
Boron (Dissolved) ug/L	01020	992.2	852.7	1,139.6	920.1	643.0	669.0
Manganese (Dissolved) ug/L	01056	454.4	--	--	--	--	--
Sulfate (Dissolved) mg/L	00946	1,400.0	90.4	26.2	36.6	53.3	50.4
Total Dissolved Solids (TDS) mg/L	70300	2,000.0	281.8	284.4	503.8	338.2	260.0
Unfiltered Parameters							
Boron (Total) ug/L	01022	1,621.0	894.0	--	1,121.0	674.0	--
Sulfate (Total) mg/L	00945	1,400.0	115.1	--	22.0	55.0	--

Attachement 2 - Continued

Site Name: Veolia ES Zion Landfill
Site Number: 0978020002

IEPA Permit No: 1995-343-LFM
Permit Log No: 2018-275

Parameter	STORET	Monitoring Wells								
		C129	G131	G132	G160	G161	G162	G163	G164	G165
Field Parameters										
pH	00400	--	--	--	--	--	--	--	--	--
Specific Conductance (umhos/cm)	00094	--	--	--	--	--	--	--	--	--
Indicator Parameters										
Boron (Dissolved) ug/L	01020	--	--	--	--	--	--	--	--	--
Chromium (Dissolved) ug/L	01030	10	10	10	10	10	10	10	10	10
Magnesium (Dissolved) mg/L	00925	163	3.5	3.5	48.2	76.6	72	51.2	65.6	63.3
Sulfate (Dissolved) mg/L	00946	--	--	--	--	--	--	--	--	--
Total Dissolved Solids (TDS) mg/L	70300	--	--	--	--	--	--	--	--	--

Parameter	STORET	Monitoring Wells								
		G167	G168	G169	G175	G176	G177	G178	G179	G180
Field Parameters										
pH	00400	--	--	--	--	--	--	--	--	--
Specific Conductance (umhos/cm)	00094	--	637	484	2239	--	--	--	--	--
Indicator Parameters										
Boron (Dissolved) ug/L	01020	--	601	649	1369	--	--	--	--	--
Chromium (Dissolved) ug/L	01030	10	10	10	10	10	10	10	10	10
Magnesium (Dissolved) mg/L	00925	31.3	21.6	19.7	34.6	17.6	25.3	8.1	38	7.6
Sulfate (Dissolved) mg/L	00946	--	232.5	55.5	812.8	--	--	--	--	--
Total Dissolved Solids (TDS) mg/L	70300	--	668.4	415.9	1533	--	--	--	--	--

Parameter	STORET	Monitoring Wells								
		G181	G183	G184	G185	G191	R124	R126	R128	R133
Field Parameters										
pH	00400	--	--	--	--	--	--	--	--	--
Specific Conductance (umhos/cm)	00094	--	--	--	--	--	--	--	--	--
Indicator Parameters										
Boron (Dissolved) ug/L	01020	--	--	--	--	--	--	--	--	--
Chromium (Dissolved) ug/L	01030	10	10	10	10	10	10	10	10	10
Magnesium (Dissolved) mg/L	00925	6.5	22.5	5.1	11.8	36.9	82.1	340.9	8.7	3.9
Sulfate (Dissolved) mg/L	00946	--	--	--	--	--	--	--	--	--
Total Dissolved Solids (TDS) mg/L	70300	--	--	--	--	--	--	--	--	--

Attachement 2 - Continued

Site Name: Veolia ES Zion Landfill
Site Number: 0978020002

IEPA Permit No: 1995-343-LFM
Permit Log No: 2018-275

Parameter	STORET	Monitoring Wells								
		R166	R182	R193	T003	T004	G170	T005	T006	--
Field Parameters										
pH	00400	--	--	--	--	--	--	--	--	--
Specific Conductance (umhos/cm)	00094	--	--	--	555	834	799	--	--	--
Indicator Parameters										
Boron (Dissolved) ug/L	01020	--	--	--	615	660	--	--	--	--
Chromium (Dissolved) ug/L	01030	10	10	10	10	10	10	10	10	--
Magnesium (Dissolved) mg/L	00925	44.6	48.7	5.8	25.9	36.4	34.5	10.9	19.5	--
Sulfate (Dissolved) mg/L	00946	--	--	--	71.8	212.5	--	--	--	--
Total Dissolved Solids (TDS) mg/L	70300	--	--	--	373.9	421.3	--	--	--	--

Parameter	STORET	Monitoring Wells								
		GG2S	RE2S	G201	G202	G203	G204	G205	G206	GF7S
Field Parameters										
pH	00400	--	--	--	--	--	--	--	--	--
Specific Conductance (umhos/cm)	00094	--	--	--	--	--	--	--	--	--
Indicator Parameters										
Boron (Dissolved) ug/L	01020	4,616	--	--	--	--	--	--	--	--
Chloride (Dissolved) mg/L	00941	--	174	--	--	--	--	--	--	**268**
Chromium (Dissolved) ug/L	01030	--	--	**10**	**10**	**10**	**10**	**10**	**10**	--
Magnesium (Dissolved) mg/L	00925	--	--	**19.4**	**20.3**	**19.5**	**17.3**	**17**	**18.5**	--
Sulfate (Dissolved) mg/L	00946	--	--	--	--	--	--	--	--	**1003**
Total Dissolved Solids (TDS) mg/L	70300	--	--	--	--	--	--	--	--	**1935**
Boron (Total) ug/L	01022	4,095	--	--	--	--	--	--	--	--
Potassium (Total) mg/L	00937	6.56	--	--	--	--	--	--	--	--
Chloride (Total) mg/L	00940	--	184	--	--	--	--	--	--	**295**
Sodium (Total) mg/L	00929	130	--	--	--	--	--	--	--	--
Sulfate (Total) mg/L	00945	--	--	--	--	--	--	--	--	**1030**

APPENDIX Q.3
Typical As-Built Diagrams for Groundwater Monitoring Wells

Illinois Environmental Protection Agency — Well Completion Report

Site Number: ____________ County: ____________

Site Name: ____________ Well #: ____________

State Plane Coordinate: X _____ Y _____ (or) Latitude: ____ ° ____ ' ____ " Longitude: ____ ° ____ ' ____ "

Borehole #: ____________

Surveyed by: ____________ IL Registration #: ____________

Drilling Contractor: ____________ Driller: ____________

Consulting Firm: ____________ Geologist: ____________

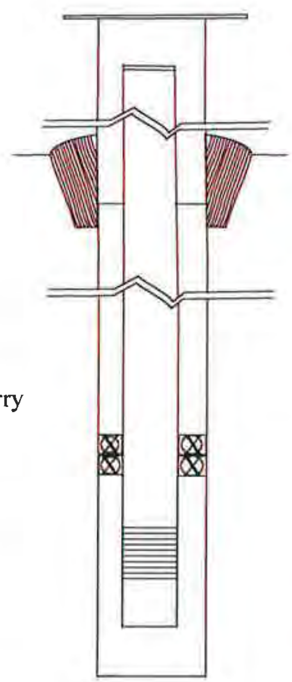
Drilling Method: ____________ Drilling Fluid (Type): ____________

Logged By: ____________ Date Started: ____________ Date Finished: ____________

Report Form Completed By: ____________ Date: ____________

ANNULAR SPACE DETAILS

Elevations (MSL)* **Depths (BGS)** **(.01ft.)**



Elevations (MSL)*	Depths (BGS)	
____	____	Top of Protective Casing
____	____	Top of Riser Pipe
____	____	Ground Surface
____	____	Top of Annular Sealant
____	____	Static Water Level (After Completion)
____	____	Top of Seal
____	____	Top of Sand Pack
____	____	Top of Screen
____	____	Bottom of Screen
____	____	Bottom of Well
____	____	Bottom of Borehole

* Referenced to a National Geodetic Datum

Type of Surface Seal: ____________

Type of Annular Sealant: ____________

Installation Method: ____________

Setting Time: ____________

Type of Bentonite Seal - - Granular, Pellet, Slurry
(Choose One)

Installation Method: ____________

Setting Time: ____________

Type of Sand Pack: ____________

Grain Size: _______ (Sieve Size)

Installation Method: ____________

Type of Backfill Material: ____________
(if applicable)

Installation Method: ____________

CASING MEASURMENTS

Diameter of Borehole (inches)	
ID of Riser Pipe (inches)	
Protective Casing Length (feet)	
Riser Pipe Length (feet)	
Bottom of Screen to End Cap (feet)	
Screen Length (1st slot to last slot) (feet)	
Total Length of Casing (feet)	
Screen Slot Size **	

**Hand-Slotted Well Screens are Unacceptable

WELL CONSTRUCTION MATERIAL
(Choose one type of material for each area)

Protective Casing	SS304, SS316, PTFE, PVC, or Other
Riser Pipe Above W.T.	SS304, SS316, PTFE, PVC, or Other
Riser Pipe Below W.T.	SS304, SS316, PTFE, PVC, or Other
Screen	SS304, SS316, PTFE, PVC, or Other

Well Completion Form (revised 02/06/02)

APPENDIX Q.4
IEPA Well Construction Report Form and Well Abandonment Form

Illinois Department of Public Health
WATER WELL CONSTRUCTION REPORT

Date ____________

TYPE OR PRESS FIRMLY WITH BLACK INK PEN. COMPLETE WITHIN 30 DAYS OF WELL COMPLETION AND SEND TO THE APPROPRIATE HEALTH DEPARTMENT

1. Type of Well a. **Driven** Well Casing diam. ______in. Depth ________ft.
   b. **Bored** Well Buried Slab ☐ Yes ☐ No
   Hole Diameter _____in. to _______ft.; ____in. to_______ft.; ____in. to_______ft.
   c. **Drilled** Well **PVC** casing Formation packer set at depth of _______ft.
   Hole Diameter _____in. to _______ft. _____in. to_______ft. ____in. to_______ft.

Type of Grout	# of Bags	Grout Weight	From (ft.)	To (ft.)	Tremie Depth (ft.)

d. **Drilled** Well **Steel** Casing- - - Mechanically Driven ☐ Yes ☐ No
Hole Diameter ____in. to ______ft. _____in. to______ft. ____in. to______ft.

Type of Grout	# of Bags	Grout Weight	From (ft.)	To (ft.)	Tremie Depth (ft.)

e. Well finished within ☒ Unconsolidated Materials ☐ Bedrock

f. Kind of Gravel Sand Pack	Grain Size/Supplier #	From (ft.)	To (ft.)

2. Well Use ☐ Domestic ☐ Irrigation ☐ Commercial ☐ Livestock ☒ Monitoring ☐ Other
3. Date Well Completed ______________ Well Disinfected ☐ Yes ☒ No
   Driller's estimated well yield ____________gpm
4. Date Permanent Pump Installed________________
5. Pump Capacity __________gpm Set at (depth) ___________ft.
6. Pitless Adapter Model and Manufacturer ____________________
7. Well Cap Type and Manufacturer ____________________
8. Pressure Tank Working Cycle_________gals. Captive Air ☐ Yes ☐ No
9. Pump System Disinfected ☐ Yes ☐ No
10. Name of Pump Company ____________________
11. Pump Installer ____________________ License # __________
12. ____________________ License # __________
    Licensed Pump Contractor Signature

Illinois Department of Public Health
Division of Environmental Health
525 W. Jefferson St.
Springfield, IL 62761

DO NOT write on these lines

IMPORTANT NOTICE: This state agency is requesting disclosure of information that is necessary to accomplish the statutory purpose as outlined under Public Act 85-0863 **DISCLOSURE OF THIS INFORMATION IS MANDATORY** This form has been approved by the Forms Management Center

GEOLOGICAL AND WATER SURVEY WELL RECORD

13. Property Owner ____________________ Well # __________
14. Driller ____________________ License # __________
15. Name of Drilling Co. ____________________
16. Permit No. ____________________ Date Issued __________
17. Date Drilling Started ____________________
18. Well **SITE** address ____________________
19. Township Name ____________________ Land ID # __________
20. Subdivision Name ____________________ Lot # __________
21. Location a. County ____________________
    b. Township _________ Range _______Section ________
    c.______ Quarter ____Quarter _____ Quarter
    d. Coordinates ______________ Site Elevation ____ ft. (msl)

For Survey Use

22. Casings, Liners* and Screen Information

Diam. (in.)	Material	Joint	Slot Size	From (ft.)	To (ft.)

(*) ____________________
(List reason for liner, type of upper and lower seals installed)

23. Water from ________________at a depth of ________ft. to ________ft.
a. Static water level _____ ft. below casing which is ____in. above ground
b. Pumping level is _____ ft. pumping _____gpm after pumping for _____hours

24. Earth Materials Passed Through	From (ft.)	To (ft.)

(If **dry hole**, fill out log and indicate how hole was sealed.)

25. Licensed Water Well Contractor Signature ____________ License Number ____________

SEE REVERSE SIDE FOR ADDITIONAL INFORMATION)

Print Form

ILLINOIS DEPARTMENT OF PUBLIC HEALTH
DIVISION OF ENVIRONMENTAL HEALTH
525 W. JEFFERSON ST.
SPRINGFIELD, IL 62761

WATER WELL SEALING FORM

PDF FILLABLE/SAVABLE

RETURN ALL COPIES TO IDPH OR LOCAL HEALTH DEPARTMENT

This form shall be submitted to this Department or the local health department not more than 30 days after a water well, boring or monitoring well is sealed. Such wells are to be sealed not more than 30 days after they are abandoned in accordance with the sealing requirements in the Illinois Water Well Construction Code. THE LOCAL HEALTH DEPARTMENT OR REGIONAL PUBLIC HEALTH DEPARTMENT MUST BE NOTIFIED AT LEAST 48 HOURS PRIOR TO SEALING.

1. Ownership (Name of Controlling Party)

2. Well Location: Well Site Address City Zip

Lot # Land I.D.# County Effingham Township

Range Section SW Quarter of the SW Quarter of the NW Quarter

GPS: North Degrees Minutes Seconds West Degrees Minutes Seconds

Report decimal minutes to minutes and seconds by multiplying the decimal part of the minutes by 60, e.g. latitude 38 degrees 46.07 minutes N would be latitude 38 degrees 46 minutes 4.2 seconds (0.07 x 60 = 4.2) N. Report GPS coordinates to the nearest 0.1 second.

3. Year Drilled 4. Drilling Permit Number (and date, if known

5. Type of Well Drilled 6. Total Depth (ft.) Diameter (in.)

7. Formation clear of obstruction Yes

8. Detains of Plugging (bentonite, neat cement or other materials)

Filled with		From (ft.)		to (ft.)	
Kind of plug		From (ft.)		to (ft.)	
Filled with		From (ft.)		to (ft.)	
Kind of plug		From (ft.)		to (ft.)	
Filled with		From (ft.)		to (ft.)	
Kind of plug		From (ft.)		to (ft.)	

9. CASING RECORD Upper 2 feet of casing removed No 10. Date well was sealed

11. Licensed water well driller or other person approved by the Department performing well sealing

Name Complete License Number

Address City State Illinois Zip Code

This state agency is requesting discolsure of information that is necessary to accomplish the statutory purpose as outlined under Public Act-0863. Disclosure of this information is mandatory. This form has been approved by the Forms Management Center. IL 482-0631- Revised 5/09

Questions regarding the completion of this form should be directed to the local health department or the Illinois Department of Public Health 217-782-5830, TTY (for hearing impaired only) 800-547-0466.

APPENDIX Q.5
Sampling Procedures

SAMPLING PROCEDURES

The procedure for collecting a representative sample from a groundwater or leachate monitoring well typically consists of the following six basic steps:

Step 1 - Preparations
Step 2 - Well Inspection/Measurements
Step 3 - Decontamination of Sampling Equipment
Step 4 - Low Flow Monitoring for Stabilization
Step 5 - Low Flow Collection of Representative Samples
Step 6 - Cleanup and Decontamination

These steps are discussed in detail below.

Step 1 - Preparations

1. A sample kit will be prepared. It will contain (at a minimum) the proper number and sizes of sample containers, a sturdy cooler or ice chest, preservatives, chain of custody forms, cold packs, and protective packaging. The selected environmental laboratory will provide complete sample kits for each sampling event. Cold packs will be refrigerated prior to traveling to the field. Alternatively, bags of ice will be purchased while en route to the site.

2. The site manager will be contacted a minimum of 24 hours prior to the sampling event to confirm the date(s) that personnel will be on site.

3. Field personnel will review the standard operating procedures for groundwater sampling and organize all necessary equipment and paperwork before traveling to the site. Typically, the necessary equipment can be packed easily into the back of a pick up or sport utility type vehicle. A 4 wheel drive vehicle will be used to access certain monitoring well locations. Keys for access gates and monitoring well casings at closed facilities will be provided by the site representative. Keys for operating facilities will be obtained from the Site Manager upon arrival at the landfill.

4. The location of the monitoring well to be sampled will be determined. If the monitoring location is not accessible by vehicle, then all required equipment will be hand carried to the monitoring site and organized.

5. All sample container label information will be completed using a permanent, fine point marker. The selected environmental laboratory will provide blank labels or if possible, they will pre label the appropriate sample containers prior to shipping the sample kits. As a minimum, the completed label will include:

    - Parameter(s) to be tested
    - Monitor well identification
    - Date of sample
    - Time of sample

- Site location
- Project number
- Identification of sampler

This information will also completed for the chain of custody forms.

When not in use, sample containers will be stored in the sample kit (cooler) with the lid closed. DO NOT OPEN THE SAMPLE CONTAINERS PRIOR TO USE AT THE MONITORING WELL LOCATION.

6. A "clean area" will be established near the monitoring well where the sample containers and equipment will be stored while not in use. Every effort will be made to keep the sampling equipment and containers from contacting the ground surface. If necessary, a disposable tarp will be used as a ground spread to prevent potential contamination of the sample containers. Typically, the back of the field vehicle will be used as the "clean area".

7. A clean, 8 ounce, wide mouth glass jar will be set out in a convenient place near the well. The jar will be used to contain an aliquot of groundwater to monitor the pH, conductance, and temperature values during well purging.

Step 2 - Well Inspection/Measurements

The padlock from the well protector will be removed and hung in the eyelet of the open cover. The outer well protector will be visually inspected. Any deterioration of the grout plug at the base of the well protector or any difficulty in opening the well protector will be noted. The well will be inspected for any signs of tampering or other deterioration. Any abnormalities will be reported to the Site Manager.

The volume of static water in the well will be determined so that a minimum of three well volumes can be purged from the well, if possible. Wells will only be purged to the top of the well screen to prevent volatilization of organics. The procedures below will be used to determine the volume of static water in a monitoring well.

1. The inner protective well casing cap will be removed and placed in the "clean area".

2. The static water level elevation will be determined. An electronic water level indicator will be used to determine water levels inside the monitoring well casing. Water level measurements will be recorded from the top of the inner well casing to the water surface to the nearest 0.01 foot.

3. The depth to the bottom of the well will be measured every time the well is sampled using either the electronic water level indicator, a weighted tape measure, or a bottom of well sounder. DEPTH TO BOTTOM IS NOT COLLECTED FROM THE LEACHATE MONITORING PORTS. Any discrepancies between the measured well depth and the well depth will be recorded on the as built diagram. When not in use, the water level measurement tools will be placed in the "clean area".

4. The well volume in the groundwater monitor well will be calculated. This calculation is not required for leachate monitor well sampling. Well volume is calculated by using the following formula:

$$V = 23.5r^2L$$

where:

V = Well volume to be calculated (gallons).

r = Inside radius of the well casing (feet).

L = Elevation of the static water level minus the elevation of the bottom of the well (feet).

All monitoring well information will be recorded such as identification, static water level, well volume, date, time, etc., on a typical groundwater sampling summary form.

Step 3 - Decontamination

Prior to purging or collecting any samples, all equipment that will be in contact with the sample will be cleaned by use of a spray bottle away from the well or using the following decontamination (decon) procedures:

1. Mix a solution of standard lab/industrial cleanser, such as Alconox, and distilled water according to the directions on the packaging.

2. Thoroughly clean all equipment that will be in contact with the samples with the solution using a stiff brush.

3. Thoroughly rinse with generous amounts of DISTILLED water.

4. Any cleaner and distilled water will be disposed of away from the well (surface flow away from the well) in an area that will not cause erosion or stress vegetation.

Step 4 - Low Flow Monitoring For Stabilization

The specific sampling method used to collect groundwater samples will be indicated on the Illinois EPA's Chemical Analysis Forms (LPC 160). Specifically, if low-flow groundwater sampling is conducted, an "L" shall be recorded in space 60. If another sampling method is utilized, an "F" shall be recorded in space 60.

If a dedicated pump has been installed in a well, it shall be located in the middle or slightly above the middle of the screened interval. Where the well is screened across the water table, the dedicated pump intake shall be located at the top of the water column. Due to on-site construction activities, it may be necessary to place the pump intake lower in the well to assure sample recovery. Low-flow groundwater samples shall not be collected within 24 hours of low-flow pump equipment installation. When collecting groundwater samples using dedicated low-flow groundwater sampling equipment, the groundwater samples shall be collected using either one of two low-flow sampling methods, low-rate pumping or passive sampling. These methods and the criteria for selecting the specific method are described below:

(1) Low-Rate Pumping – Low-rate pumping shall be used at wells where it has been found that a low-flow rate can be established with a drawdown of less than 0.1 meter and with minimal fluctuation of the water level during pumping. At these wells, the flow rate should not exceed 0.5 liter/minute. Groundwater samples will be collected at these wells as follows:

a) A water level probe or pneumatic probe will be lowered into the well to determine the static water level and to monitor water level during the initial low-flow groundwater sampling activities. Once recharge characteristics have been determined for the well, the data can be used as guide for conducting subsequent sampling events.

b) Initially, the pump shall be operated at the minimum flow capacity of the pump, then gradually increased until some initial drawdown is observed. The flow rate then will be reduced slightly to achieve a stabilized pumping water level drawdown of less than 0.1 meter. This pumping rate will be established as the maximum purge rate for that well. In any case, the flow rate shall not exceed 0.5 liter/minute.

c) The well shall be purged at the maximum purge rate until the indicator parameters, pH, temperature, and specific conductivity have stabilized. Indicator parameters shall be monitored no less than 1 minute and no more than 5 minutes apart using a flow through cell or hand held field meter. Stabilization of the field parameters shall be considered complete when 3 consecutive readings are within ± 0.1 unit or 1% for pH, ± 5% for specific conductance, and ± 0.5º C or 3% for temperature of the measured unit.

d) Groundwater samples shall be collected immediately following purging and indicator parameter measurement.

(2) Passive Sampling – Where the yield of the well is too low to maintain minimal drawdown at very low pumping rate, 0.5 liter/minute or less, the well will be sampled by purging only 1.5 to 2 times the volume of the sampling equipment and tubing. Groundwater samples will be collected at these wells as follows:

a) A water level probe or pneumatic probe will be lowered into the well to determine the static water level and to monitor water level during the initial low-flow groundwater sampling activities. Once recharge characteristics have been determined for the well, the data can be used as guide for conducting subsequent sampling events.

b) If the yield of the well is too low to maintain minimal drawdown in the well at a very low pumping rate, 0.5 liter/minute or less, the well will be sampled by purging only 1.5 to 2 times the volume of the sampling device and tubing.

c) If filtration of the groundwater sample is necessary, an in-line filtration device may be utilized. If necessary, the filter shall be pre-rinsed following the manufacturers guidelines. If pre-rinsing is not necessary, a minimum of one liter of groundwater shall be passed through the filter following purging and prior to sampling.

d) Groundwater samples shall be collected immediately following purging.

In addition to the protocols outlined above, low-rate pumping protocols for wells with extremely slow recharge characteristics (those that cannot be sampled at any purge rate without exceeding the drawdown limit) will allow drawdown to exceed the 0.1 meter mark and will be sampled after one pump and tubing volume is removed from the well. In these wells, water levels will only be monitored to ensure that drawdown is not below the screen where the screen interval is fully saturated or below the pump intake where the screen interval is only partially saturated.

Sample Temperature

This measurement is made in all water samples at the time and place of well purging and sampling. Typically an electronic thermometer is placed in the aliquot of sample water. Allow the thermometer to equilibrate for approximately 20 seconds before recording the temperature. Note the units of measurement, i.e. in degrees Celsius or Fahrenheit.

Specific Conductance (Conductivity) of the Sample

1. Insert the conductivity probe or "stick" into the sample aliquot and turn the switch on to obtain a reading.

2. Record the instrument reading. Note the units of measurement, i.e. µmohs/cm or µS/cm.

pH Measurement of the Sample

1. Remove the probe cap and insert the pH probe or "stick" into the sample aliquot and turn the instrument on.

2. Allow the instrument to equilibrate (approximately 20 seconds) before recording the pH value.

3. Rinse the probe or "stick" electrode with distilled water and replace the cap.

No field measurements will be taken in samples which are to be submitted to the laboratory for analysis.

The electronic temperature, conductance, and pH probes are sensitive instruments, and require periodic calibration. Refer to the instrument manufacturer's instructions regarding calibration, handling and storage procedures. ALWAYS CLEAN THE INSTRUMENTS AFTER USE.

Step 5 - Low Flow Collection of Representative Samples

1. If preservatives have not already been added to the sample containers by the laboratory, add the sample preservatives to the appropriate containers and loosely replace the caps (the environmental laboratory should provide instructions as to which preservatives are to be added to specific sample containers). Extreme caution will be used when adding the preservatives because some of them are highly concentrated acids.

2. All equipment that will be in contact with the groundwater will be decontaminated in accordance with the procedures described above.

3. A representative sample of groundwater will be obtained using low flow sampling methods (either low rate pumping or passive sampling as described in the previous section). Care will be taken to not agitate the samples to cause volatilization of VOAs. The sample containers will be carefully filled. A decontaminated stainless steel, glass, or fluorocarbon resin funnel and a ring stand device may be set up above the sample container to be used to assist with filling the containers. All sample bottles except VOAs will be filled to within one (1) inch of the top. VOA samples will be carefully filled to over flowing and then capped to prevent the formation and/or inclusion of any air bubbles. Check for bubbles by inverting the container and shaking it. If bubbles are present, the jar will be re filled. This is to avoid cross contamination of the sample preservatives. Excessive agitating of samples will be avoided. The sample containers will be filled in order of their susceptibility to volatilization. The following order is recommended by the U.S. EPA in RCRA Groundwater Monitoring Technical Enforcement Guidance Document (OSWER 9950.1):

    a. Volatile organics (VOA)
    b. Purgeable organic carbon (POC)
    c. Purgeable organic halogens (POX)
    d. Total organic halogens (TOX)
    e. Total organic carbon (TOC)
    f. Extractable organics
    g. Total metals
    h. Dissolved metals
    i. Phenols
    j. Cyanide
    k. Sulfate and chloride
    l. Turbidity
    m. Nitrate and ammonia
    n. Radionuclides

4. Sample container lids will be placed in the “clean area” while filling the sample container. The sample containers will be immediately capped after they have been filled.

5. If filtration of the groundwater sample is necessary, an inline filtration device may be utilized. If necessary, the filter shall be pre-rinsed following

the manufacturers guidelines. If pre-rinsing is not necessary, a minimum of one liter of groundwater shall be passed through the filter following purging and prior to sampling.

In the event a sample cannot be filtered in the field, the clean sample storage container will be preserved at approximately 4 degrees Celsius and allowed to stand for up to 24 hours. This will allow the fine suspended material to settle from the sample. The clear portion of the sample will be poured into a second clean container, leaving the sediment in the initial container. The sample in the second container can then be filtered using the previously described procedure.

6. Each sample container will be placed in the sample kit cooler immediately after it has been filled. The inside temperature of the cooler will be maintained at 4 degrees Celsius, i.e. using frozen cold packs or ice.

7. If dictated by the method being used to analyze a sample for a particular constituent, aliquots will be preserved with an appropriate preservative as listed in Attachment 1 of this Sampling Protocol.

8. To prevent breakage during transport, protective packaging such as bubble wrap or Styrofoam will be used on sample containers. The sample kits will be handled as extremely fragile.

9. The chain of custody form will be completed. This form will accompany the samples during all aspects of sample collection, handling, and transport.

10. The sample kit will be secured during transport.

Step 6 - Clean Up and Decontamination

1. The protective cover will be closed and the lock replaced.

2. All disposable solid waste such as disposable coveralls, gloves, plastic tarps, aluminum foil, etc. will be collected and packed into a plastic trash bag for disposal into an on site trash container. All such trash will be treated as non hazardous unless warranted otherwise by conditions at the site.

3. All non dedicated field equipment (field instruments, work gloves, etc.) will be decontaminated prior to use at any other groundwater monitoring locations.