# Enclosure 2

# Draft Response to RAI NP-2.4-x with SAR Markups

**RAI NP-2.4-1:**

Provide technical justification for the rating curve of the large playa next to the WCS CISF storage area. This may include the outflow area cross section, the equation and parameters used to calculate the curve, and the details of the calculations under all surface water flow scenarios.

In the WCS request for supplemental information response dated December 16, 2016, WCS provided a flood calculation package of the CISF drainage area built on the U.S. Army Corps of Engineer's HEC-HMS model. ISP provided a rating curve of discharge from the large playa depression in the calculation package. ISP also provided outflow rates from the playa for a few surface water flow scenarios in Attachment B to SAR Chapter 2, Site Characteristics. However, the information provided in the attachment did not include the cross-section of the playa outflow area or the equation and parameters to calculate the outflow rates all the way to the top of the cross-section. The NRC staff requires the additional information to verify the rating curve used for the 2016 floodplain study.

This information is needed to determine compliance with 10 CFR 72.90(f) and 72.92(c).

**Response to RAI NP-2.4-1:**

Outflow from the large playa next to the WCS CISF storage area is calculated using a Hydrologic Modeling System (HMS) program developed by the U.S. Army Corps of Engineers' Hydrologic Engineering Center (HEC). The large playa next to the WCS CISF storage area is modeled as a reservoir element in HEC-HMS with an outflow structure routing method. To simulate flow out of the large playa (reservoir), the non-level dam top routine is used, which is described in Chapter 9 of Reference [1], the User's Manual for version 4.0 of the HEC-HMS computer program.

Using the non-level dam top method allows the outflow area from the large playa to be represented by a cross-section defined by eight station elevation pairs. A separate flow calculation is performed for each segment, and the total flow rate is calculated by combining the flow rate across the segments. The method assumes that each of the segments behave like a broad crested weir.

The equation or rating curve used by the HEC-HMS program for a broad crested weir is given in Chapter 10 of Reference [2], the Technical Reference Manual for the HEC-HMS computer program:

$$O = CLH^{1.5}$$

Where: O = flowrate over the weir; C = dimensional discharge coefficient; for a broad crested weir, L = effective weir width; and H = difference between the weir crest elevation and water surface elevation in the reservoir.

The flood calculation package of the CISF drainage area dated December 16, 2016, provides calculations and design data that are utilized as input data for the HEC-HMS program. The HEC-HMS non-level dam top routine using the broad crested weir equation and cross-section data internally generates a rating curve for outflow from the large playa and pairs it with the elevation-storage data to predict the peak storage, elevation, and discharge. The effective weir width and *the* difference between the weir crest elevation and water surface elevation in the reservoir is calculated within the HEC-HMS program using the eight station elevation pairs provided in Appendix C, page APP C-12, (weir width and elevation) and the elevation storage data in Appendix D, page APP C-9 (water surface elevation in the playa).

Routine inputs into the program include elevation-storage data, cross-section data, and a discharge coefficient. Post development elevation-storage data for the large playa used in the model are found in Appendix C, page APP C-9. The large playa cross-section data, along with reference notes that were used in the non-level dam routine, are provided in Appendix C, page APP C-12. The HEC-HMS model cross section for the large playa is named "DA 4 OVERTOP" and is in the model components tab under cross-sections in the paired data folder on the CD provided in Appendix E, HEC-HMS Input. A discharge coefficient of 2.6 is used for all segments of the non-level dam top routine for the playa and is found in Appendix E as a basin parameter input of the "Dam Top 1" component found in the Dam Tops folder under the playa reservoir hydrologic element.

Two extraneous paired data functions are also found in Appendix E in the paired data folder of the model input. Neither the elevation-discharge component named "Playa Road Rating Curve" nor the inflow-diversion component named "AP-4" *is* connected to any of the Basin Models and, therefore, do not affect the model results/output. The two functions can be deleted with no change to the model output or the conclusions reached in the flood calculation package of the CISF drainage area dated December 16, 2016. Attachment B, Flood Plain Report, to SAR Chapter 2 has been revised to remove the extraneous data from Appendix E.

**References:**

1. Hydrological Modeling System (HEC-HMS), US Army Corps of Engineers, Hydrological Engineering Center, User's Manual, Revision 4.0, December 2013.

2. Hydrological Modeling System (HEC-HMS), US Army Corps of Engineers, Hydrological Engineering Center, Technical Reference Manual, March 2000.

**Impact:**

Attachment B to *SAR* Chapter 2 has been revised as described in the response.

See Enclosure 5 for Attachment B to SAR Chapter 2

**RAI NP-2.4-2:**

Provide additional information on the erodibility and long-term erosion of the diversion berms, under normal and extreme precipitation events, through all phases of the proposed WCS CISF facility. Estimate the seepage through and underneath the berms and the impact of seepage to the berms' stability through all phases of the proposed facility.

In WCS CISF SAR Section 2.4.2.2, ISP stated that flood events are modeled without including the collection ditch and diversion berms to provide the greatest possible area contributing runoff to the playa that serves as a water detention pond and potentially to increase the water level of the playa. ISP stated that the ditch and berm are to be constructed to minimize, not prevent, run-on of storm water by diverting it around the operational storage area. ISP stated that compromise of the collection ditch and diversion berms upstream of the CISF facility may result in increased flow across the storage area during some precipitation events. ISP further stated that this increase of flow would be short term and temporary in nature. However, because of the build-up of water and sediment behind the berm can potentially create a flood water wave higher than those modeled without the berm in the event that the berm is breached. The NRC staff requires additional information to evaluate the likelihood that events and processes (e.g., overtopping, breach of berm structure, and short- and long-term erosion) may negatively impact the integrity of the system, structure and component in the storage area. Additionally, the NRC staff requires the estimates of seepage through and underneath the berms and the impact of the seepage to the berms' stability through all phases of the proposed CISF facility to evaluate potential impact of subsurface water to the foundation of the storage pads.

This information is needed to determine compliance with 10 CFR 72.90(f).

**Response to RAI NP-2.4-2:**

As discussed in SAR Section 2.4.2.2 and shown on *SAR* Figure 2-26, a stormwater collection ditch and berm are to be constructed up-gradient from the WCS CISF storage area.

Berms and ditches up-gradient of the storage area will be constructed of on-site available compacted red bed clay and armored with on-site available caliche in order to minimize erosion and seepage. The construction of the berms and ditches will occur during the first phase of the facility. Additional berms and ditches will not be needed for later phases. Inspection of the berms for erosion and ditches for sediment buildup will be part of the ongoing routine inspection operations for the facility during all phases. The area between the berms and the storage pads will also be routinely inspected for erosion, especially after a rainfall. Areas of the site impacted by erosion and sediment buildup will be repaired to original grades. Inspection and maintenance will occur after normal and extreme precipitation events and through all phases of the facility.

It is unlikely that seepage through or under the berms would occur due to the materials used to construct the berms and to the routine inspections and maintenance performed on all areas up-gradient of the storage pads. The berms and ditches are for diverting stormwater around the operational storage area and any water behind the berm is temporary*; t*herefore, seepage should not impact the stability of the berms. If any seepage were to occur through the berms, subsurface water would have to flow horizontally approximately 470 feet to reach the nearest storage pad, which is not possible due to the sub strata of the site.

The drainage area up-gradient of the collection ditch and diversion berms is characterized predominantly by sand dunes with no clear drainage pathways visible on topographic maps of the area. The soils in this area are classified as hydrologic group A/B, which means the soils have high infiltration and transmission rates as shown on Attachment B, Flood Plain Report, Figure No. 2.2.1-1, Soils Boundary Map of the SAR. Stormwater runoff from these sand dunes is highly unlikely; therefore, the potential of a flood water wave occurring behind the berm is extremely low.

The maximum berm height will be 2.6 feet. The site will be graded so that stormwater runoff flows off and around the storage pads. Assuming the berm were to breach and the peak Probable Maximum Precipitation discharge reached a storage pad (Phase 8), the estimated depth of flow on the ground surface is approximately 3 inches. See Addendum A of the Flood Plain Report for calculations, methodologies, assumptions, and the figure for this worst-case scenario. As the flow from the worst-case berm breach moves southeastward, the depth of the water continues to diminish as it spreads out, thus *further* mitigating any possibility of flooding the storage pads.

In the unlikely event that the collection ditches become full and overtop the berm, the stormwater will flow through the site to the large playa without negatively impacting a system, structure, *or* component in the storage area. The overflow amount would be extremely low, if any at all, and this event would occur after the peak flow event occurs on the storage area due to the long time-of-concentration of the drainage area up-gradient of the collection ditch. The storage area is graded to sheet flow to the playa and runoff flows off and around the storage pads.

SAR Chapter 2, Section 2.4.8 has been updated to include information regarding the berms, maintenance, potential breach, and seepage.

SAR Chapter 2, Attachment B, Flood Plain Report has been updated to include information regarding the berm's construction, inspection and maintenance, and calculations regarding the potential berm breach.

**Impact:**

SAR Section 2.4.2.2 has been revised as described in the response.

The updated Flood Plain Report, Attachment B to SAR Chapter 2, is included with the response to RAI NP-2.4-1.

The WCS CISF Drainage Evaluation and Floodplain Analysis (Attachment B) models the 100-year flood, the 500-year flood and the PMF to evaluate the effects on the WCS CISF.

The only analysis of significance from a flooding standpoint is the water level in the playa area resulting from the PMP event. The result is that the WCS CISF storage area is above the maximum water level elevation resulting from that storm event as demonstrated in Attachment B. The area west of the WCS CISF drains freely and does not result in any ponded water to create a flood area near the WCS CISF.

As noted previously, a stormwater collection ditch and berm are to be constructed up-gradient from the WCS CISF storage area. The ditch and berm are to be constructed as a matter of operational convenience to minimize (not prevent) run-on of stormwater during precipitation events by diverting it around the operational storage area. Figure 2-26 (CJI Drawing C-1) show the location of the Collection Ditch and Berm. Figure 2-27 through Figure 2-30 (CJI Drawings C-2, C-3, C-4, and C-5) show plan and profile of the collection ditch and berm. Berms and ditches upgradient of the storage area will be constructed of on-site available red bed compacted clay and armored with on-site available caliche in order to minimize erosion and seepage. It is unlikely that seepage through or under the berms would occur due to the materials used to construct the berms and to the routine inspection and maintenance performed on all areas upgradient of the storage pads. The storage area is sloped to promote drainage across the area, which will result in short-term overland flow of stormwater falling directly on the storage area during some precipitation events. The overland flow across the storage area will be temporary in nature. Compromise of the ditch and berm may result in increased flow across the storage area as a result of some precipitation events, but again, it would be short term and temporary. The maximum berm height will be 2.6 feet. The site will be graded so that stormwater runoff flows off and around the storage pads. Assuming the berm were to breach, and the peak Probable Maximum Precipitation discharge reached a storage pad, the estimated depth of the flow is approximately 3 inches (Addendum A of Attachment B). The storage pad area is approximately three times the area from which run-on might emanate, thus the majority of the overland flow results from the stormwater that falls directly on the pad. The area upgradient of the storage area is predominately a sand dune area with little to no developed drainage paths, which has the effect of lessening the overland flow of water from that area during the storm events. In order to provide a conservative analysis of the flood effects, the flood events are modeled without including the collection ditch and berms, which provides the greatest possible area contributing runoff into the playa.

As indicated in Section 4.0 of the December 2016 revision of the March 2016 report entitled *Centralized Interim Storage Facility Drainage Evaluation and Floodplain Analysis* (Attachment B of SAR Chapter 2):

"The local PMP [probable maximum precipitation] floodplain analysis yielded the PMF elevation near the CISF site of 3488.9 ft msl. Elevations of the storage pads vary from 3490 ft msl to 3504 msl. Elevations of the foundations of the security/administration building and the Cask Handling Building are 3496 ft msl and 3493 ft msl, respectively."

The finish floor elevations of the Security and Administration building and the Cask Handling Building are 7 feet and 4 feet, respectively, above the PMF elevation and will not be impacted by the PMF. The detailed calculations for determining the water level elevations in the playa can be found in Attachment B.

2.4.2.3 Effects of Local Intense Precipitation

The Flood Plain Study in Attachment B includes calculations for a PMP using a 500-year frequency storm event and the limits of the floodplain. The results from these additional storms that were modeled describe a floodplain that is still shallow and wide that is too distant from the WCS CISF to ever be any threat.

2.4.3 Probable Maximum Flood on Streams and Rivers

There are no streams or rivers on or in the vicinity of the WCS CISF. Monument Draw, an ephemeral stream, is the closest main surface water drainage and is about 3 miles west of the WCS CISF in New Mexico, so the WCS CISF would be unaffected by flooding on streams of rivers. While Monument Draw is typically dry, the maximum historical flow occurred on June 10, 1972 and measured 36.2 cubic meters per second (1,280 cubic feet per second).

2.4.4 Potential Dam Failures (Seismically Induced)

There are no dams on or in the vicinity of the WCS CISF. The Waste Control Specialists RCRA and LLRW facilities currently have five (5) manmade evaporation ponds used for sedimentation control and evaporation. In addition to the WCS ponds, there are a series of manmade ponds to the southwest in New Mexico. As indicated in Section 2.6.5, the maximum elevation of the embankment structure of any of these ponds is lower than the minimum elevation of any structure at the CISF. If a seismic event were to cause slope failure, the inherent topography would preclude any adverse effects to the CISF.

2.4.5 Probable Maximum Surge and Seiche Flooding

Surges and seiches are typically observed on lakes or seas. There are no surface bodies of water on or near the WCS CISF where such a phenomenon would be a safety concern at the WCS CISF. There are currently five evaporation ponds at the Waste Control Specialists site and they are designed with spillways on the south side so any seiche or surge would flow south away from the WCS CISF.

**RAI NP-2.4-3:**

Provide clarification as to what is the exact design of WCS CISF rail side track, in particular the section east of the storage area.

In its 2016 floodplain analysis, ISP considered four drainage areas in the watershed encompassing the WCS CISF (i.e., P DA 1, P DA 2, P DA 3, and P DA 4, see SAR Figure 2-35). ISP stated that drainage area P DA 3 contains 42.8 acres and drains the southeast portion of the CISF site bounded by the existing WCS railroad and the CISF rail side track and that surface water runoff from P DA 3 discharges into the large playa located east of the facility (SAR Chapter 2 attachment B).

In reviewing the SAR, the NRC determined that the eastern portion of the CISF rail side track are not consistently identified in the site plan depicted in SAR Figures 2-1, 2-3, 2-4 and 2-15 versus that depicted in SAR Figure 2-35 and SAR Chapter 2, Attachment B, Figures 1.1.2-2 and 2.2.1-1. The drainage area P DA 3 depicted in the former group of figures appears to be larger than that depicted in the latter. Difference in the area of drainage P DA 3 may cause different flood water level on the south eastern corner of the storage area. If drainage area P DA 3 is correctly depicted in SAR Figure 2-35, the NRC staff requests that ISP correct the side rail track design in SAR Figures 2-1, 2-3, 2-4 and 2-15. If drainage area P DA 3 is correctly depicted in SAR Figure 2-1, the NRC request that ISP provide a floodplain analysis using the site plan in Figure 2-1.

This information is needed to determine compliance with 10 CFR 72.90(a) and (f).

**Response to RAI NP-2.4-3:**

The actual WCS CISF rail side track layout is shown in SAR Figures 2-26 and 2-35, which are in agreement with the floodplain analysis. SAR Figures 2-1, 2-3, 2-4, and 2-15 show the rail for orientation purposes only. To clarify this, SAR Figures 2-1, 2-4, and 2-15 have been updated with a note that indicates that the rail side track is shown for orientation purposes only and that the actual rail layout is shown on SAR Figures 2-26 and 2-35. SAR Figures 2-26 and 2-35 both show the relationship between the location of the rail line and the drainage playa for drainage area P DA 3. SAR Figure 2-3 has been updated in response to RAI NP 2.2-2 and no longer shows the rail side track.

**Impact:**

SAR Figures 2-1, 2-4, and 2-15 have been revised as described in the response.

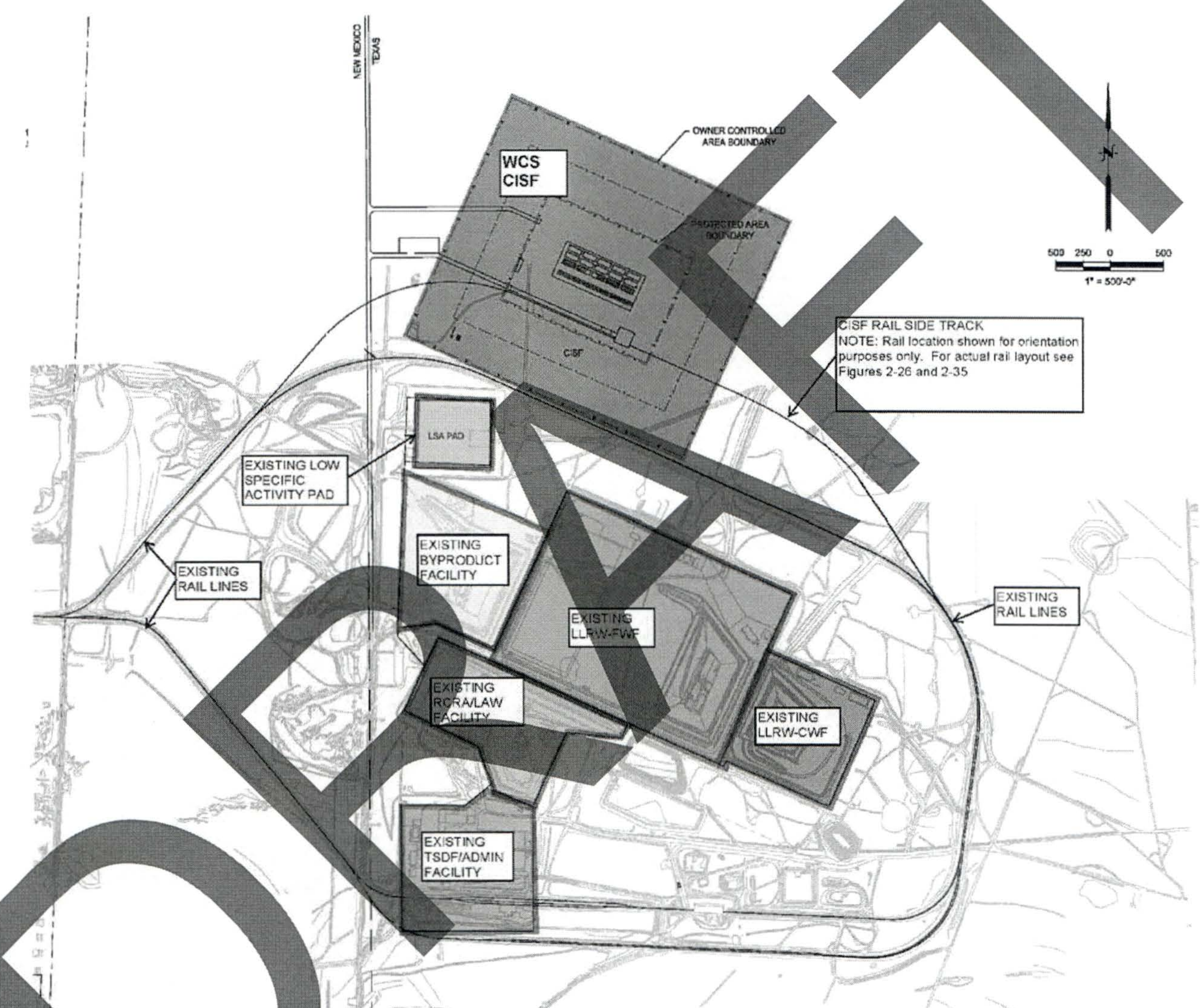
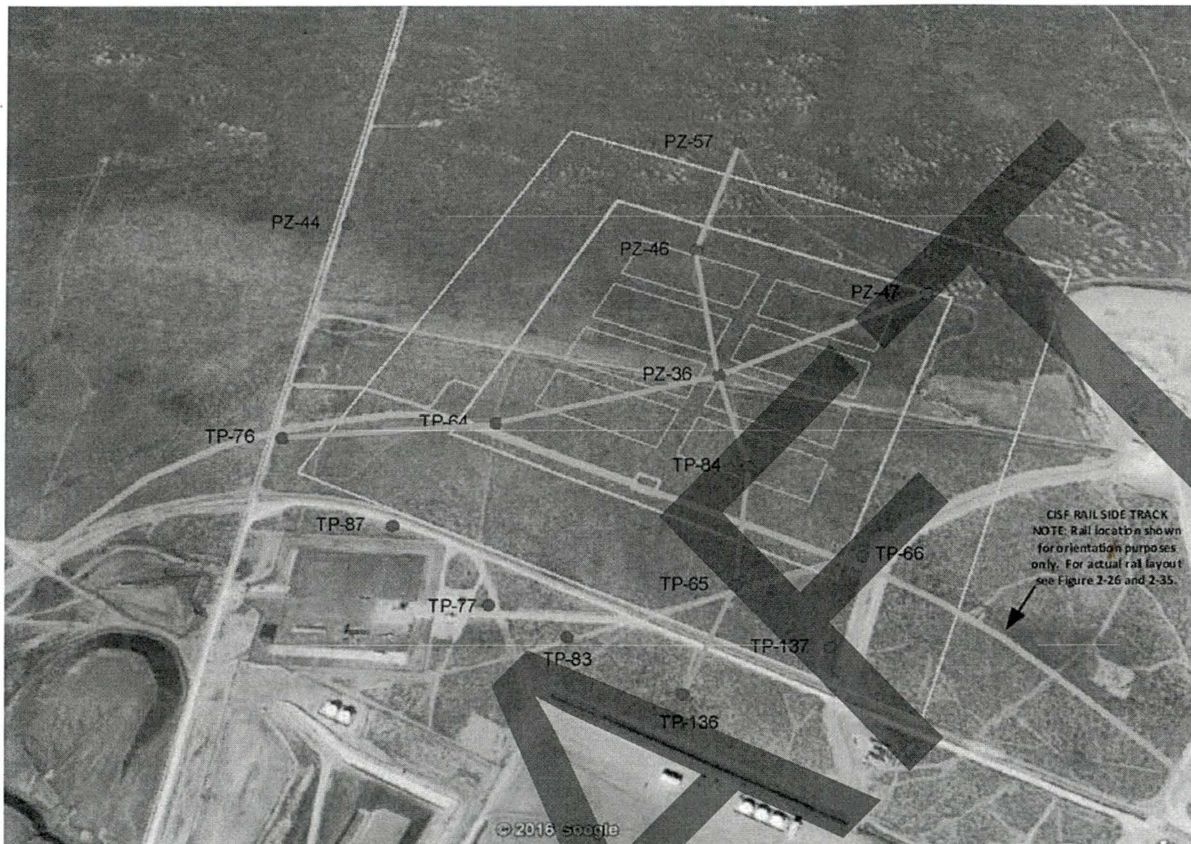



**Figure 2-1**
**Waste Control Specialists Facility Site Plan**


**Figure 2-4**
**Wind Rose Location Map**




| Monitoring Well/ Piezometer Name | Date Drilled/ Completed | Total Depth Well (ft btoc) | Bottom of Well Elevation (ft msl) | Ground Elevation (ft msl) | Top of Casing Elevation (ft msl) | Depth to Red Bed Claystone (ft bgs) | Top of Red Bed Claystone (ft msl) |
|---|---|---|---|---|---|---|---|
| PZ-36 | 7/20/05 | 78.98 | 3419.51 | 3494.79 | 3498.49 | 75.0 | 3419.79 |
| PZ-44 | 1/22/08 | 82.98 | 3416.90 | 3496.59 | 3499.88 | 77.1 | 3419.49 |
| PZ-46 | 1/23/08 | 93.83 | 3412.04 | 3502.38 | 3505.87 | 87.4 | 3414.98 |
| PZ-47 | 1/24/08 | 92.22 | 3411.56 | 3500.60 | 3503.78 | 87.0 | 3413.60 |
| PZ-57 | 1/23/08 | 99.56 | 3415.44 | 3511.79 | 3515.00 | 93.5 | 3418.29 |
| TP-64 | 1/11/08 | 70.81 | 3433.99 | 3502.08 | 3504.80 | 65.3 | 3436.78 |
| TP-65 | 1/11/08 | 57.68 | 3436.07 | 3490.40 | 3493.75 | 52.5 | 3437.90 |
| TP-66 | 1/10/08 | 57.78 | 3430.88 | 3485.45 | 3488.66 | 51.0 | 3434.45 |
| TP-76 | 2/7/08 | 53.42 | 3436.78 | 3487.06 | 3490.20 | 47.1 | 3439.96 |
| TP-77 | 2/7/08 | 51.30 | 3436.09 | 3484.19 | 3487.39 | 45.4 | 3438.79 |
| TP-83 | 2/11/08 | 55.55 | 3435.60 | 3487.77 | 3491.15 | 49.8 | 3437.97 |
| TP-84 | 2/12/08 | 65.24 | 3429.59 | 3491.56 | 3494.83 | 58.7 | 3432.86 |
| TP-87 | 3/15/08 | 49.02 | 3438.47 | 3484.17 | 3487.49 | 43.3 | 3440.87 |
| TP-136 | 3/20/09 | 55.21 | 3438.01 | 3490.17 | 3493.22 | 50.5 | 3439.67 |
| TP-137 | 3/20/09 | 56.46 | 3434.68 | 3488.00 | 3491.14 | 51.5 | 3436.50 |

**Figure 2-15**
**Boring Locations in the Vicinity of the WCS CISF**