

Supplement to DEC Required EAP Post-Incident Report Form
Gilboa Dam EAP Activation, 12:15 pm, 8/28/11

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SUBJECT: Gilboa Dam EAP Activation, 12:15 hours, 8/28/11
(Hurricane Irene Flood Event)

DATE: August 30, 2011

Report of the timeline of events and conditions observed by DEP personnel and representatives of the Design Team during each day onsite are as follows:

Friday – August 26, 2011

Bureau of Water Supply (BWS) personnel had been conducting storm preparations during the week preceding the event at Gilboa Dam. This included distribution of updated contact information, portable communication devices, and equipment and vehicle placement. At 12:00 hours Western Operations Division (WOD) staff conducted a final briefing before the weekend and scheduled update briefings for 16:30 hours on Saturday and Sunday. Predictions at that time were for the Gilboa spill to peak approximately at elevation 1131.8 feet. The Gilboa spillway control section crest line is at elevation 1130 feet with a 221 foot gated crest notch at 1125.07 feet on the west end. Key Operations personnel, including Dam Safety, were instructed to keep communications open and be prepared for call-out if needed.

Saturday – August 29, 2011

Updated storm predictions showed the Gilboa Dam would spill at approximately 1131.4 feet. At approximately 12:30 hours BWS personnel conducted a conference call with NYS DEC Dam Safety Section, Schoharie County Office of Emergency Management, and various elected officials of downstream towns. Discussed were enhanced preparations for the event and specific aspects of the construction activities ongoing at the dam. In particular, the Schoharie County OEM and members of the County Board of Supervisors were to be notified if a section of temporary bulkhead, 4 ½ high and 200 feet long, constructed along the eastern end of the spillway control section crest, were to fail during the storm. BWS agreed to post staff on site as elevations approached 1130 feet and maintain a 24 hour watch until the elevations dropped. Mark Suttmeier, DEP Regional Engineer would be posted on site Sunday morning and would

make notifications if the bulkhead failed. At this time Tom DeJohn of DEP WOD Dam Safety was also scheduled to report to the dam at 14:00 hours Sunday to assess the situation. At that time the National Weather Service predicted that the reservoir elevation would not peak until sometime Sunday evening.

Sunday – August 28, 2011

At approximately 09:00 hours Tom DeJohn was notified to report early to the Gilboa Dam. He was to meet with Mark Suttmeier on site. Actual pool elevations showed water levels rising much faster than predicted as the storm began to intensify. Between 09:30 and 11:00 hours regional staff and Mark Suttmeier reported they could not reach the dam. Jeff Helmuth, Deputy Chief Engineering & Tech Support was also turned around and Tom DeJohn was still in route. Video feed of the dam and telemetry was being monitored at the Grahamsville Water Supply Control Center (WSCC) and the DEP Police from the Gilboa Precinct (just below the dam) were on site at the east overlook area of the dam. At approximately 09:00 hours the DEP Police reported what appeared to be leakages at the 4 ½ foot tall, 200 foot long temporary bulkhead covering the constructed crest notch at the east end of the spillway. This information was immediately relayed to the DEP WSCC and forwarded to the Schoharie County EOC and certain members of the Schoharie County Board of Supervisors per discussions the previous day. The temporary bulkhead was estimated to have failed around 10:40 hours. Access to the main section of the dam from the west gate (Gate 19) for DEP Police was blocked due to water flowing over the bridge at State Route 990V.

At 12:04 hours the four extensometers at the dam went into alarm condition, however they were within a safe range based on engineering guidance incorporated into the control center standard operating procedure. At approximately 12:05 hours Deputy Commissioner Paul Rush, initiated a conference call to discuss the rapidly developing situation at Gilboa Dam. On this call also were WOD Chief, WOD Dam Safety, Bureau of Engineering Design and Construction (BEDC), and the Design Team (DT) from Gannett Fleming/Hazen and Sawyer. During this teleconference, at 12:08 hours, all communication was lost to the instrumentation. At approximately 12:10 hours the video feed of the dam was lost as well (note there is no time stamp on video). At approximately 12:15 hours and while on the teleconference, it was agreed to activate the Gilboa Dam's emergency action plan (EAP) to code Orange (or Type B) emergency. The decision was made based on reports that the reservoir level at the dam was predicted to exceed prior record levels, there was a possible spike in extensometer readings transmitted from the dam, and because all video and data communication from the dam was lost not long after that spike. The spike in instrumentation readings were a possible indication of unacceptable movement of the spillway control section. The decision was also made to have Design Team engineers Rod Holderbaum and Robert Kline travel to the dam site to assist with condition assessments. DEP initiated the EAP notification roster (this includes the DEP Police and Schoharie County

Officials). The Water Supply Control Center also notified the Schoharie County Emergency Management Officer with a telephone call to her mobile phone. DEP Police notified Schoharie County at 12:36 hours by phone. Schoharie County initiated an evacuation of the projected inundation areas.

The DT members (Rod Holderbaum and Robert Kline) departed home at approximately 13:40 hours on Sunday. While travelling, they received several e-mail messages containing photos of the dam during near-peak flow conditions. Tom DeJohn arrived at the west end of the dam at approximately 13:50 hours and gave an initial report to the WSCC, now designated the Emergency Operations Center (EOC), by radio and by e-mail. The preliminary email assessment of conditions at the dam was forwarded to the DT. While in route to Gilboa Dam, the DT and Jeff Helmuth were re-directed to Stewart International Airport, where, weather permitting, a helicopter was being arranged for a flyover of the dam. The DT arrived at Stewart International Airport at approximately 17:15 hours, however, winds were too high to permit a helicopter flyover. While at Stewart Airport, a brief meeting was held with DEP Commissioner Carter Strickland, Deputy Commissioner (BWS), Paul Rush (via phone) and DEP Police. During that meeting the DT provided a preliminary assessment of conditions at the dam based on photos and the condition assessment received by e-mail during the trip to Stewart Airport. Following the meeting the DT was given a police escort to the dam site by DEP Police Chief Frank Milazzo.

From 14:00 to 15:10 hours Tom DeJohn provided updates of conditions at the dam from his vantage at the West Parapet. Included were results of a complete walk through of the earthen section of the dam. No leakages were noted on the earthen section or obvious stability issues with the control section and the spill line across the crest appeared true and level. However the extraordinary spill elevation obscured most of the more detailed features of the control section. At approximately 15:10 hours Captain Handy of the DEP Police arrived at the West Parapet. The Captain stated that flows in the Schoharie had receded below the deck of the bridge at 990V so Tom DeJohn and Captain Handy went to inspect the east overlook area of the dam. Upon arrival Tom DeJohn noted that East Training Wall of the dam was stable and secure as were recent construction stabilization measures at the east overlook area. From this position the control section also appeared stable and consistent with observations made at the West Parapet.

At approximately 20:00 hours Jeff Helmuth and Mark Suttmeier arrived at the East Abutment of the dam. The DT departed Stewart International Airport about 17:30 pm, but did not arrive at the dam until about 21:40 hours, because of numerous area-wide road closures and detours. Upon arrival at the site, it was noticed that DEP Police had flood lights set up at the east abutment of the dam to assist with observing conditions at the dam, however, it was still difficult to make any observations beyond the east end of the dam/spillway because of the overall low lighting conditions and spray from the spillway overflow. Erosion was observed on portions of the downstream side of the North Training Wall, primarily from flow impinging on the temporary

access ramp through the North Training Wall into the Side Channel. The DT did not judge this to be a dam safety concern. During the visit, the DT viewed photos taken by Tom DeJohn and DEP Police and were briefed on conditions observed at the site during daylight hours by Tom DeJohn, Jeff Helmuth, and Mark Suttmeier. The reservoir level was reported to be dropping quickly and was estimated to be at approximately Elevation 1132 feet when the DT departed the site at 23:00 hours.

Earlier in the day, extensometer data from the dam was transmitted to the DT by DEP. Observed instrument readings immediately prior to loss of data transmission revealed data that was inconsistent with readings that would be expected during the observed spillway flow conditions. Similar anomalous readings had been observed previously (approximately two years earlier) during a data transmission interruption. Therefore, it is believed that the anomalous readings were the result of the data transmission interruption that occurred on Sunday afternoon. This can be confirmed, if data can be recovered onsite from the extensometer data recorders.

At approximately 23:00 hours the DT departed the dam to the nearest available hotel accommodations located in Oneonta, New York (45 minute drive time to dam site), Jeff Helmuth and Tom DeJohn headed home, Mark Suttmeier was stationed at the Gilboa Precinct, and DEP Police rotated shifts at the east overlook area of the dam.

Monday – August 29, 2011

At 00:03 hours, Rod Holderbaum sent an e-mail message to DEP representatives at remote locations to provide notes on their observations during Sunday night's site visit.

On Monday morning, at approximately 8:15 am, Design Team representatives met with representatives of BWS and BEDC to more fully assess conditions at the dam site during daylight hours and at a point in time when spillway flow discharges significantly receded so that the various spillway features were less obscured by spillway flows. Figure 2 shows a NEXRAD radar image of the precipitation that occurred within the Schoharie Reservoir watershed during Hurricane Irene to provide rainfall depth and aerial distribution information (Source: NOAA Advanced Hydrologic Precipitation Service).

Upon arrival, the reservoir level was observed to be below El. 1130 feet (primary spillway crest level) and steadily receding as shown in the outflow hydrograph for the spillway (Figure 1) published by the US Geological Survey based on onsite electronic level sensor readings.

Based on field observations received at the EOC from DEP staff and the DT on Sunday and at first light Monday, the DEP determined that conditions warranted standing down from condition

Orange (or Type B) for the Gilboa Dam EAP and proceeded with notification to emergency services personnel and the general public .

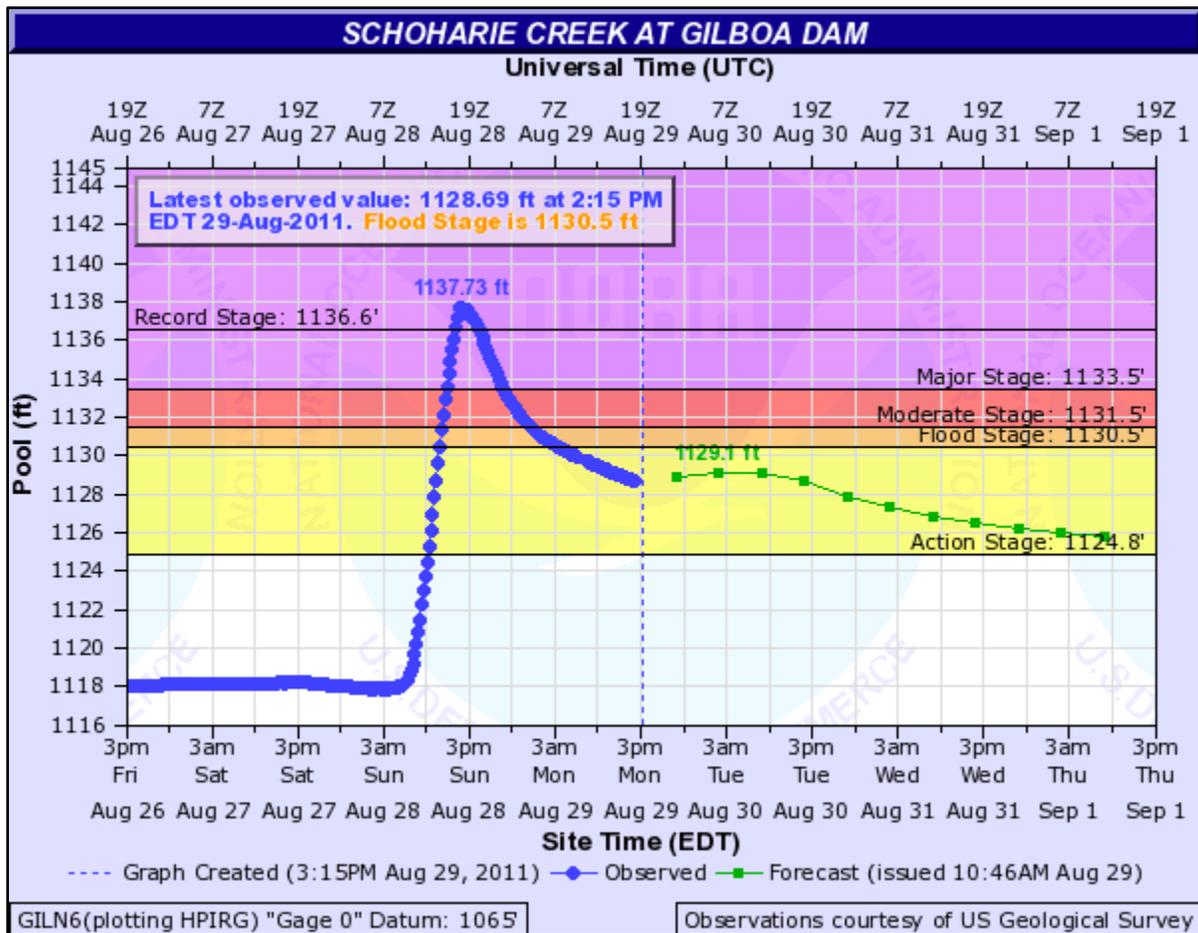


Figure 1: This outflow hydrograph provides a plot of the pool level at Schoharie Reservoir versus time. This is publicly available on the USGS website. It demonstrates that the reservoir level rose and peaked very quickly, within approximately a nine-hour-period. The plot indicates that peak level occurred around 14:00 hours on Sunday, August 28th. Readings taken at the Schoharie Tunnel Intake Chamber (STIC) on the west side of the reservoir showed a peak elevation of 1137.97 feet from 14:35 to 14:55 hours.

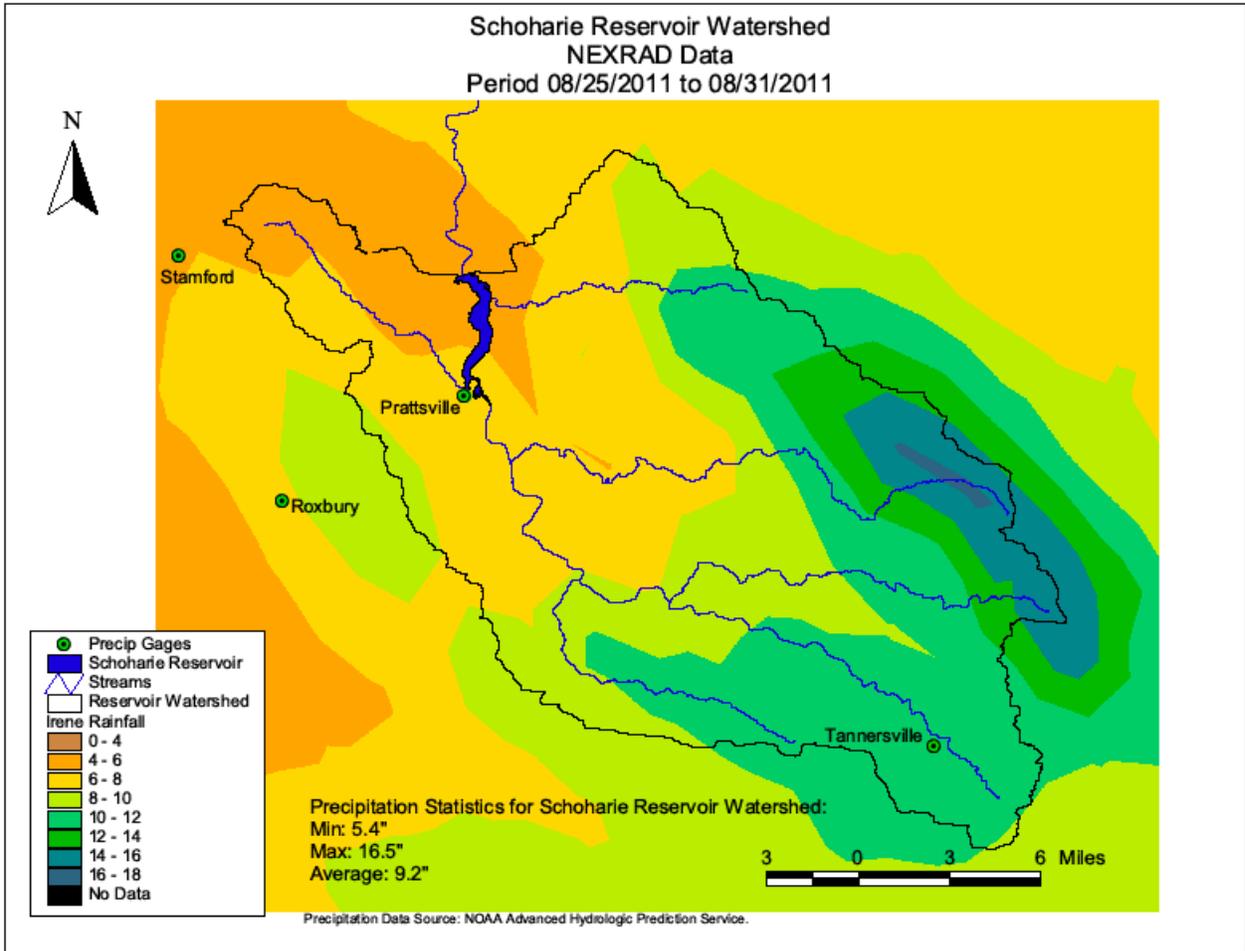


Figure 2: This figure shows a NEXRAD radar image of the precipitation that occurred within the Schoharie Reservoir watershed during Hurricane Irene to provide rainfall depth and aerial distribution information.



Figure 3: This photo shows the Control Section Crest at approximately peak spill elevation (STIC Gauge 1137.94 ft) at 14:20 hours. The photo was taken from the West Parapet above the dam's control section (west end of the spillway) looking east. During this event the STIC gauge recorded a peak reservoir elevation of 1137.97 feet from 14:35 to 14:55 hours.



Figure 4: This photo shows the Control Section Crest on the left and the spillway channel in center. Flows are still near peak spill elevation (STIC Gauge 1137.93 ft) at 15:15 hours. The photo was taken from the downstream section of the East Training Wall above the dam's spillway channel (east end of the spillway) looking west.

Wednesday – August 31, 2011

Tom DeJohn deployed to the Gilboa Dam to conduct a follow up safety inspection of the dam. Upon arrival, the reservoir level was down significantly so that flow was contained in the gated crest notch at the west end of the spillway and the crest notch constructed at the east end of the spillway. Flow was estimated to be around 1126 feet which allowed for more detailed observations of the spillway and side spill channel.

Observations of the dam's condition on Monday, 8/29/11:

1. **Concrete Spillway (Crest Length 1,324 ft):** Given the approximately 200-ft-long crest notch (El. 1124-25 ft) formed at the east end of the spillway from stone masonry demolition operations and the 221-ft-long gated crest notch (El. 1125.07 ft) at the west end of the spillway, the notch areas, spillway face directly underneath each notch, and the side channel is still obscured by spillway flows (See Figure 5).



Figure 5: This photo shows the spillway on Monday morning, August 29th. The view is from the East Training Wall facing west. In the foreground, the crest notch at the east end of the spillway created by recent stone masonry demolition activities as part of the reconstruction project is visible. Flows from the gated crest notch at the opposite end of the spillway is also visible. Flows over the stair-stepped spillway (control section) and within the side channel appear normal for this type of flow situation.

However, the flow patterns observed (see Figure 6) suggest that no significant damage occurred in the side channel floor that could expose foundation rock materials and

undermine the foundation of the spillway control section (stair-stepped weir). If significant erosion had occurred, flow patterns would be highly non-uniform at such locations.



Figure 6: This photo shows the side channel which runs below and parallel to the stair-stepped spillway (control section). The view is from the west end of the spillway. Again flows within the side channel appear normal for this type of flow situation.

There is evidence of a non-uniform flow pattern (see Figure 7) on the stair-stepped spillway control section directly below the gated crest notch which has been observed when prior flow discharges have occurred at this notch. This pattern is likely due to the partial loss of the stone masonry façade in this area.



Figure 7: This photo shows the overflow at the gated crest notch (west end) as viewed from the north side of the spillway. The anomaly (highlighted by yellow circle) in the flow pattern appears to be due to an irregular step surface that pre-existed before the hurricane. At this flow level, even a fairly minor irregularity in the spillway surface can cause a very distinct and dramatic change in the flow pattern.

The floor of the Plunge Pool area was more obscured by spillway flows than other spillway channel areas due to the greater depth of flow in this area. However, flow patterns did not appear to be unusual. Temporary structures to facilitate construction operations that were in the process of being installed in the Plunge Pool area prior to the hurricane event have suffered total loss and/or significant damage. Damage to these temporary structures should not adversely impact the performance of the spillway.

The only visible damage to the spillway appears to be isolated to the intermediate step of the side channel and one channel slab unit. Even though the intermediate channel step has undergone demolition of its stone masonry façade, a portion of the step (see Figure 8) appears to have been dislodged and pushed against the temporary steel frame structure

intended for post-tensioned anchor drilling operations for the West Training Wall. The missing portion of the intermediate step is located a reasonable distance away from the stair-stepped control section such that it is not believed to impact the structural integrity of the control section. In addition to loss of material at the intermediate channel step, it appears that one of the channel slab units near the downstream end of the channel has become dislodged (see Figure 9). There was no evidence of erosion of the underlying materials at this location.



Figure 8: The side channel meets the plunge pool area at the west end of the spillway. All spillway flows enter the natural creek downstream of the dam from the plunge pool area. At this location the side channel floor steps down by two 18-ft-high steps to reach the same level of the plunge pool floor. As highlighted by the blue circle in the photo, the intermediate step (18-ft below the end of the side channel floor and 18-ft above the plunge pool floor) appears to have suffered loss of a portion of its concrete and rock mass that forms the step due to erosion damage from spillway high flows. The dislodged portion of the intermediate step is located towards the north end of the step which is located favorably further away from the stair-stepped spillway control section. Further assessment of this damage is needed once spillway flows fully subside.



Figure 9: This photo depicts a location at the southwest corner of the side channel floor where a thin (approx. 8 inches thick) approximately 20 ft by 20 ft concrete slab has been displaced by the high spillway flows. This damage is very minor in nature and can be easily repaired once spillway flows subside.

2. **Earthfill Embankment (Crest Length 700 ft):** The curvilinear (in plan) earthfill embankment shows no signs of distress resulting from the recent record rainfall and associated spillway discharge at the dam site.
3. **Steel Siphons:** The four temporary 4-ft-diameter steel siphons appear to be completely intact and all four siphons are discharging. A close visual inspection of the siphons was not possible due to spillway flows. Leakage was observed at two locations at joints in the downleg pipe portion of Siphon No. 3. Leakage was also observed at the lower end of Siphon No. 4. The bottom most structural support for Siphon No. 1 appears to be slightly bent from some type of impact.

Recommended Interim Response Measures to Monday's Observations:

1. Since large portions of the spillway are still inaccessible and obscured, albeit to a much lesser degree than during peak record flow conditions, due to continuing receding flow discharges it is recommended that a more comprehensive inspection of the spillway be conducted as soon as conditions allow (no flow discharges from the crest notches). This near-term inspection should further assess the overall condition of the spillway as well as concentrate efforts on a more detailed assessment of the condition of the floor of the side channel and plunge pool areas, crest notch areas, and stair-stepped control sections below each crest.
2. Since the siphons were submerged by a significant depth and high velocity spillway flows, it is recommended that de-activation of the siphons be performed from the siphon crest (above El. 1130 ft) as opposed to closing the valve at the end of the downstream pipe leg due to the age, condition and present uncertainties of the structural integrity of the siphon supports and pipe segment connections. If continued future use of the siphons is planned, a full structural inspection and repair, as determined to be necessary, of each siphon should be performed. Otherwise, the siphons should be dismantled and removed from the spillway as soon as practical.

Observations of the dam's condition on Wednesday, 8/31/11:

1. **Concrete Spillway (Crest Length 1,324 ft):** Given flow elevations having receded in the spillway channel, flow patterns still suggest no damage on the channel floor to bedrock. However, there are indication of damage to two of the diamond slabs at the east end to approximately one foot depth and a possible deeper scour hole just downstream of that (see Figure 10)



Figure 10: This photo shows the Spillway Control Section (crest) and left and the side channel at center from the east Overlook Area looking west. Note the edge of one of the concrete channel slabs within the circle and the irregular flow pattern just downstream. This may indicate a deeper scour section

Flow patterns at the lower water elevations continue to suggest no significant damage occurred in the side channel floor that could expose bedrock. However, flows at the east end of the channel are still obscuring the possible scour hole previously discussed. Also, the possible damage to the 20' x20' concrete slab towards the western end of the side channel discussed in Figure 9 can now clearly be seen here and confirmed (see Figure 11). This damage appears to be minor and can easily be repaired once flows subside.



Figure 11: This photo shows the Spillway Side Channel from the West Parapet looking east. Note the loss of the channel slab indicated within the circle at center.

Evidence of non-uniform flow patterns on the stair-stepped spillway control section discussed in Figure 7 are not observed at the lower flows. This suggests that the anomalies were formed at the higher flows and from irregularities previously observed in the gated notch crest (see Figure 12 and Figure 13).



Figure 12: This photo shows the Gated Notch Crest from the north side of the side channel looking southwest. Note the slight flow irregularities indicated by the red arrows. These were noted in previous inspections and are scheduled for repair under the current construction contract.



Figure 13: This photo shows the Notch Crest from the West Parapet in May 2008. Note the same points (again indicated by red arrows) where material is missing and as indicated in Figure 12. The higher flows on Monday are believed to have caused the flow anomalies observed.

A clearer view of the plunge pool than was allowed on Monday reveals the movement of a section of demolition debris from the intermediate step of the side channel. This loss of material however does not present a near-term risk to the safety or stability of the dam itself (see Figure 14).



Figure 14: This photo shows the Plunge Pool from the West Parapet looking north. Note the large piece of debris lodged against the framework of the drilling platform in the red circle on left. It is believed to be from the Intermediate Step on right.

2. **Earthfill Embankment (Crest Length 700 ft):** The curvilinear (in plan) earthfill embankment shows no signs of distress resulting from the recent record rainfall and associated spillway discharge at the dam site.
3. **Steel Siphons:** The observations made on Monday were confirmed. It was also noted that a flange cap on Siphon No. 4 was either lost or the entire flange torn away. The condition of the siphons should be assessed once the reservoir elevation recedes.
4. **Interior Stairs, Valve Chamber and West Wall Adit:** An inspection of the Upper Gallery at the West Parapet, the Interior Stairs and the West Wall Adit showed no signs of distress from the spill event or damage not observed during previous dam safety inspections.

Recommended Interim Response Measures to Tuesday's Observations:

1. Since large portions of the spillway are still inaccessible and obscured, due to continuing receding flow discharges it is recommended that a more comprehensive inspection of the spillway be conducted as soon as conditions allow (no flow discharges from the crest notches). This near-term inspection should further assessments as recommended in Monday's inspection.
2. Initiate measures for emergency evaluation and repair work at the dam, dam access, and construction staging areas as well as all supporting systems.

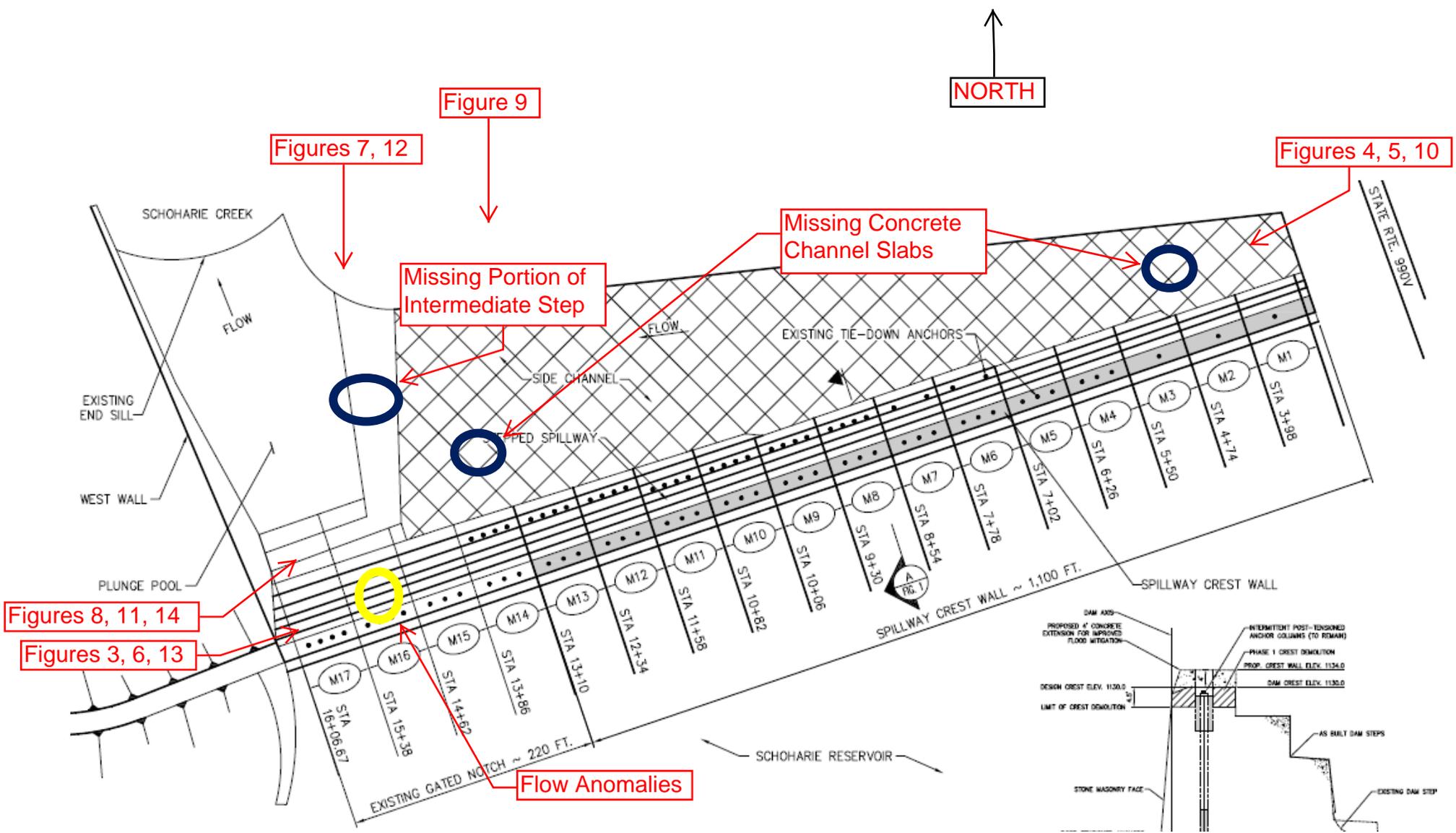


Photo Legend

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