



STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY

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April 18, 2017

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APR 21 2017

Department of Ecology
Eastern Regional Office

Brendan Dowling
Department of Ecology Eastern Regional Office
Toxics Cleanup Program
4601 N. Monroe Street
Spokane, WA 99205

Subject: Van Stone Mine, Tailings Pond Dam; Dam Safety file no. ST 61-0608
Dam Safety Inspection, summary findings and required remedial actions

Dear Mr. Dowling:

This letter summarizes our findings from the June 29, 2016, inspection of the Van Stone Mine, Tailings Pond Dam. We discussed some of these items in the field during the on-site inspection, although some items surfaced later during our review of our photographs and field notes from the inspection.

This inspection found that the dam is in unsatisfactory physical condition. From our inspection, we observed the following items that need attention, correction or repair:

Embankment, Abutments and Foundation. The embankment is comprised of sandy, erodible tailings material. More detailed descriptions are given in the Reclamation Plan by Beacon Hill Consultants (1999) in section 6.3.1 on pages 14 and 15, and in the previous inspection report by Dam Safety (Ma and Blacklaw, 2008) on pages 2 and 3.

The embankment appears to be in similar condition as described in these previous reports, with similar deficiencies. The erosion damage to the embankment slopes should be repaired, and the slopes re-graded to a stable, smooth, even slope. In conjunction with this, an erosion-resistant cover or surface should be established or installed on the embankment slopes.



As noted in the previous inspection report (Ma and Blacklaw, 2008), the steep embankment slopes have a constructed bench that breaks up the total height of the embankment. This bench serves as a drainage swale that accumulates runoff from the upper portion of the embankment and redirects it down-slope at specific overflow locations. As described in the 1999 Reclamation Plan (Beacon Hill Consultants, 1999), these overflow locations are intended to be rock-lined channels that convey the runoff down the steep embankment slope. The erosion damage to the drainage swales (benches) and to the steep conveyance channels needs to be repaired, and the erosion-resistant lining for the conveyance channels needs to be restored.

The Tailings Pile Stability Analysis by Hart Crowser (2013) notes that the tailings embankment is only marginally stable and does not meet Dam Safety stability criteria with regard to factor of safety. The Dam Safety Office (DSO) requires that the embankment should be evaluated for current condition of slope stability including seismic stability analysis. All analyses of the embankment stability should be completed by a professional engineer, licensed in the State of Washington, and an engineering report should be submitted to the DSO for review. If the repairs or modifications to the embankment are determined to be necessary, then a design modification plan should be submitted to the DSO for approval. Until this situation is corrected, the pond should be configured to hold only a minimal volume of water.

The previous inspection report (Ma and Blacklaw, 2008) on page 2 notes that the upper portion of the tailings pond is lined with a geo-synthetic liner, where the “upper portion” is interpreted to mean the upper 25 feet of the tailings pile constructed since 1991 (see Hart Crowser, Appendix F, 2013, page F-1). Damage to the PVC liner from exposure to sunlight was the subject of correspondence from Dam Safety in 1998, with a directive that the free water pool should be reduced to an elevation below that of the intact (undamaged) liner. The 2013 Remediation Investigation by Hart Crowser (2013, see section 4.4 on page 34) noted that cracking and weather damage was visible in exposed sections of the PVC liner, confirming the 1998 observations by Dam Safety and also indicating that repairs have not yet been made to the PVC liner. Until this situation is corrected, the pond should be configured to hold only a minimal volume of water.

Overflow Spillway. The overflow spillway is located at the NE corner of the East Cell, at the right abutment for the East Cell north berm. This spillway allows excess water to overflow from and exit the Tailings Pond.

The Reclamation Plan by Beacon Hill Consultants (1999) in section 6.3.2 on page 16, and on Figure 26 by Hallam Knight Piesold Ltd, notes that the spillway should overflow at elevation 2694 feet. The previous inspection report (Ma and Blacklaw, 2008), on the project data sheet on page 6, lists a spillway base width of 6 feet.

From a review of inspection photos from 2006, 2011 and 2016, it appears that sediment may have slumped into the spillway channel such that the spillway is no longer 6 feet wide at elevation 2694 feet. Any accumulated sediment should be removed to restore the spillway to the design geometry and overflow elevation. From elevation data for the East Cell north berm, it appears that the notch through the embankment may be around 9 feet deep at the spillway

location. From elevation data for the north berm, the notch through the berm needs to be at least 5.5 feet lower than the lowest elevation on the north berm. The overflow spillway should also overflow at the same or lower elevation than the equalizing spillway. After the spillway is reopened, the erosion-resistant channel lining should be restored.

Equalizing Spillway. The equalizing spillway is located near the center of the divider berm between the two cells. This spillway allows excess water to overflow from the West Cell into the East Cell, from where it can exit the Tailings Pond through the overflow spillway.

The Reclamation Plan by Beacon Hill Consultants (1999) in section 6.3.2 on page 16, and on Figure 26 by Hallam Knight Piesold Ltd, notes that the spillway should overflow at elevation 2694 feet. Apparently only one of the two proposed equalizing spillways was actually installed. The previous inspection report (Ma and Blacklaw, 2008), on the project data sheet on page 6, lists a spillway base width of 6 feet, specifically for the overflow spillway but presumed to apply to the equalizing spillway also.

From a review of inspection photos from 2006, 2011 and 2016, it appears that sediment may have slumped into the spillway channel such that the spillway is no longer 6 feet wide at elevation 2694 feet. Any accumulated sediment should be removed to restore the spillway to the design geometry and overflow elevation. From elevation data for the center berm, it appears that the notch through the embankment may be around 13 feet deep at the spillway location. From elevation data for the west berm, the notch through the center berm needs to be at least 3.5 feet lower than the lowest elevation on the west berm. After the spillway is re-opened, the erosion-resistant channel lining should be restored.

Operation/Inspection/Maintenance. As noted in the inspection report for the Pit Lake Dam, the operation and maintenance (O&M) manual for the Tailings Pond Dam needs to be updated to include the Pit Lake Dam. Please contact Charlotte Lattimore for additional information and guidance for updating the O&M manual. Charlotte can be reached at (360) 407-6066 or by e-mail to charlotte.lattimore@ecy.wa.gov. When it becomes available, Dam Safety will need a copy of the updated O&M manual for our files.

Emergency Preparedness. As noted in the inspection report for the Pit Lake Dam, the emergency action plan (EAP) for the Tailings Pond Dam needs to be updated to include the Pit Lake Dam. An EAP based on the simplified EAP form available from the Dam Safety Office web site would suffice. Please contact Charlotte Lattimore, Dam Safety's EAP Coordinator, for additional information and guidance for updating the EAP. Charlotte can be reached at (360) 407-6066 or by e-mail to charlotte.lattimore@ecy.wa.gov. When it becomes available, Dam Safety will need a copy of the updated EAP for our files.

Perform Annual Inspections. We request that you perform an Annual Inspection on a date of your choosing, or if you already do so, please send a copy of each completed Annual Inspection

checklist to the DSO for our file. An example form was included at the end of the report for the Pit Lake Dam. This is a requirement of all dam owners in the State of Washington.

Thank you for your cooperation in meeting state dam safety requirements. If you have any questions regarding the inspection and/or these findings, please don't hesitate to call me at (360) 407-6420, or e-mail to martin.walther@ecy.wa.gov. Thank you.

Sincerely,

Martin D. Walther

Martin Walther, P.E.
Dam Safety Engineer

Copy to: Gus Ordonez, Jintae Lee, Dam Safety geotechnical engineers (via e-mail)

Attachments: Summary of Compliance Actions
Project Data Sheet
Location map
Resources and References
Photographs
Engineering drawings

**Van Stone Mine, Tailings Dam
Project Data Sheet (2017)**

General

State I.D. No.	ST 61-0608
Owner and Operator	Dept. of Ecology ERO/TCP
Location	T 38 N, R 40 E, Sections 29 & 30 16 miles NNE of Colville
Construction Completed	1961 (initial lift)
Major Modifications	1991 (upper lift)
Purpose	Disposal of mine tailings
NPDES / State Discharge Permit No.	ST-0005287 (expired)
Downstream Hazard Potential	Significant, Hazard Class 2E
Downstream Flood Path	Onion Creek to Columbia River

Reservoir

Watershed	Off stream within Onion Creek watershed
Drainage Area	50 acres

Tailings Base Elevation	2610 feet
Spillway Overflow Elevation	2694 feet

East Cell

Dam Crest Elevation	2700 feet
Surface Area at Dam Crest	9.4 acres
Active Storage at Dam Crest	52 acre-feet (est.)

West Cell

Dam Crest Elevation	2698 feet
Surface Area at Dam Crest	7.4 acres
Active Storage at Dam Crest	22 acre-feet (est.)

Dam Embankment

Type	Mine tailings
Structural Height	90 feet
Hydraulic Height	8 feet
Crest Elevation	2700 feet
Elevation Datum	[feature] = ____ feet

Crest Length	2800 feet
Crest Width	30 feet
Upstream Slope	2.0 to 10 H:1V
Downstream Slope	1.5 to 2.5 H:1V

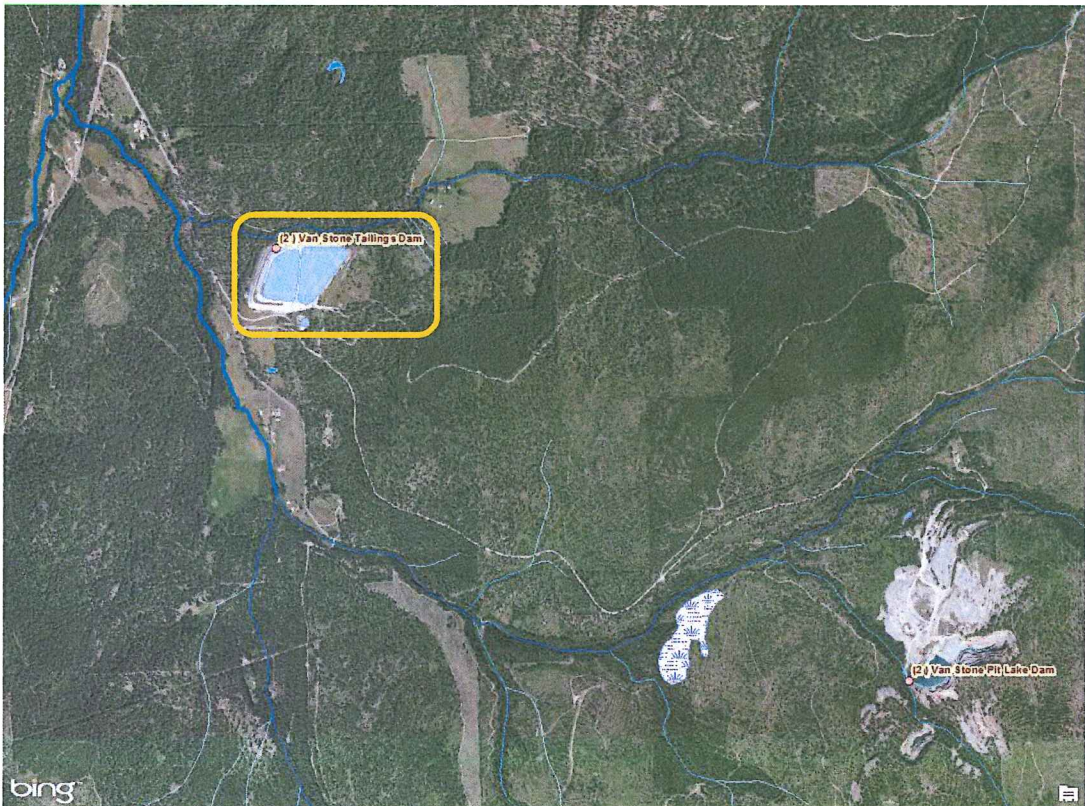
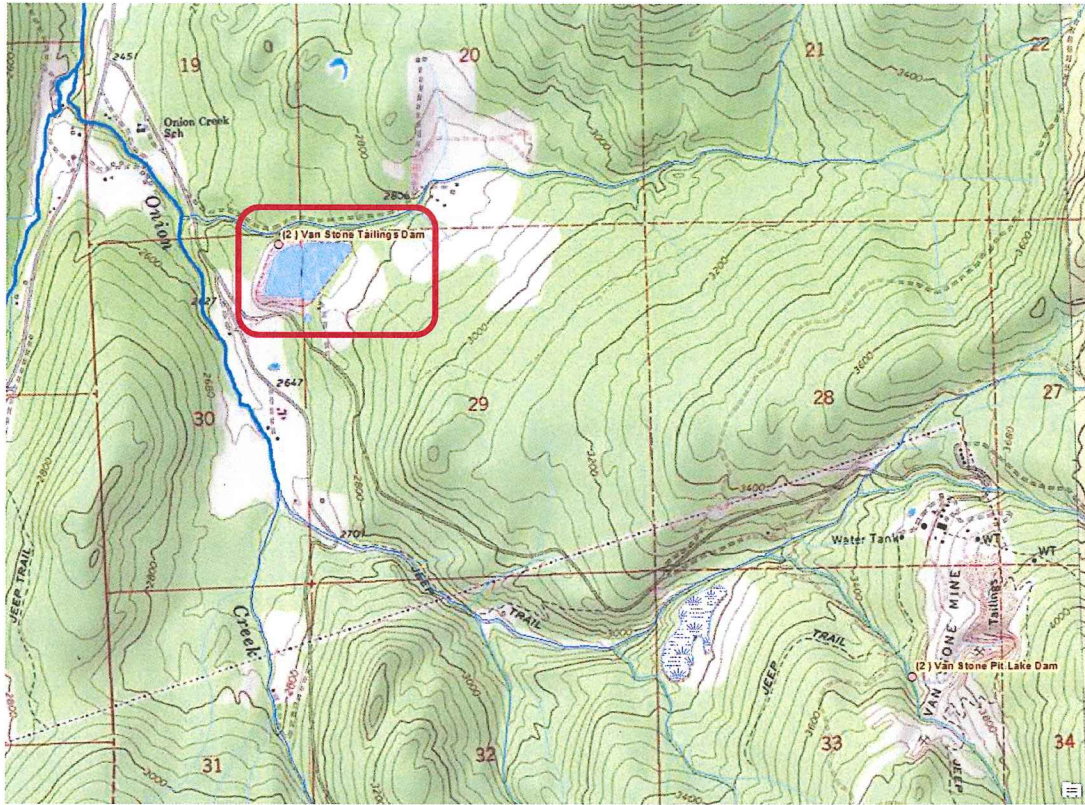
**Van Stone Mine, Tailings Dam
Project Data Sheet (2017)**

Overflow Spillway

Type	Rock-lined open channel
Location	East Cell, north berm, right abutment
Discharge Capacity	19 cfs at water level 2695.4 feet 140 cfs at water level 2698.0 feet
Overflow Elevation	2694.0.0 feet
Overflow Control Section	Base 6 feet, sides 1 H:1V, 9 feet deep
Discharge Channel – section	Base 6 feet, sides 1 H:1V, 9 feet deep
Discharge Channel – profile	75 feet long at slope -0- ft/ft.
Inflow Design Flood – Discharge	19 cfs
Inflow Design Flood – Storm	Step 2, 42% PMP; Long duration
Inflow Design Flood – Precipitation	24 hr = 3.98 inch, 72 hr = 5.76 inch (as calculated per Technical Note 3, 2009)

Equalizing Spillway

Type	Rock-lined open channel
Location	Center of center divider berm
Discharge Capacity	18 cfs at water level 2695.4 feet 130 cfs at water level 2698.0 feet
Overflow Elevation	2694.0.0 feet
Overflow Control Section	Base 6 feet, sides 1 H:1V, 13 feet deep
Discharge Channel – section	Base 6 feet, sides 1 H:1V, 13 feet deep
Discharge Channel – profile	95 feet long at slope -0- ft/ft.



Van Stone Mine, Tailings Dam location

Resources and References

Water Resources Program, Dam Safety Section. *Dam Safety Guidelines, Part III: An Owner's Guidance Manual*. Washington State Department of Ecology Publication No. 92-55C. July 1992
(available at: http://www.ecy.wa.gov/programs/wr/dams/GuidanceDocs_om.html)

Water Resources Program, Dam Safety Section. *Guidelines for Developing Dam Operation and Maintenance Manuals*. Washington State Department of Ecology Publication No. 92-21. February 1995.
(available at: http://www.ecy.wa.gov/programs/wr/dams/GuidanceDocs_om.html)

Water Resources Program, Dam Safety Section. *Guidelines for Developing Dam Emergency Action Plans*. Washington State Department of Ecology Publication No. 92-22. February 1995.
(available at: http://www.ecy.wa.gov/programs/wr/dams/GuidanceDocs_om.html)

Federal Emergency Management Agency. *Technical Manual for Dam Owners, Impacts of Animals on Earthen Dams*. FEMA Publication No. 473. FEMA. September 2005.
(available at: http://www.ecy.wa.gov/programs/wr/dams/GuidanceDocs_om.html)

Federal Emergency Management Agency. *Technical Manual for Dam Owners, Impacts of Plants on Earthen Dams*. FEMA Publication No. 534. FEMA. September 2005.
(available at: http://www.ecy.wa.gov/programs/wr/dams/GuidanceDocs_om.html)

Water Quality Program. *2004 Stormwater Management Manual for Eastern Washington*. Washington State Department of Ecology Publication No. 04-10-076. September 2004.
(available at: <http://www.ecy.wa.gov/programs/wq/stormwater/municipal/StrmwtrMan.html>)

Hart Crowser Inc. *Draft Van Stone Mine Remedial Investigation*. Hart Crowser. March 2013.

Hart Crowser Inc. *Draft Van Stone Mine Remedial Investigation. Appendix F, Tailings Pile Stability Analysis*. Hart Crowser Inc. March 2013.

Ma, F., and J.R. Blacklaw. *Periodic Inspection Report, Van Stone Tailings Dam* (unpublished report in file no. ST 61-0608). Washington State Department of Ecology, Dam Safety Office. January 2008.

Beacon Hill Consultants Ltd. *Equinox Resources Inc. Van Stone Mine Reclamation and Closure Plan*. Beacon Hill Consultants Ltd with Hallam Knight Piesold Ltd. July 1999.

Klohn Leonoff Engineers. *Geotechnical and Water Quality Data Report for the Van Stone Tailings Facility*. Klohn Leonoff Engineers. January 1990.

Photographs

[The following photos focus primarily on those areas of the dam that need attention or correction. Other photos available from Dam Safety on request.]



1. East Cell north berm upstream face, looking right (east).



2. East Cell north berm dam crest, looking right (east).



3. East Cell north berm downstream face, looking right (east).



4. East Cell overflow spillway, looking downstream (north) (2011 photo)



5. Center divider berm, looking north.



6. Center berm equalizing spillway, looking east.



7. West Cell north side dam crest, looking downstream. Erosion damage above PVC liner.



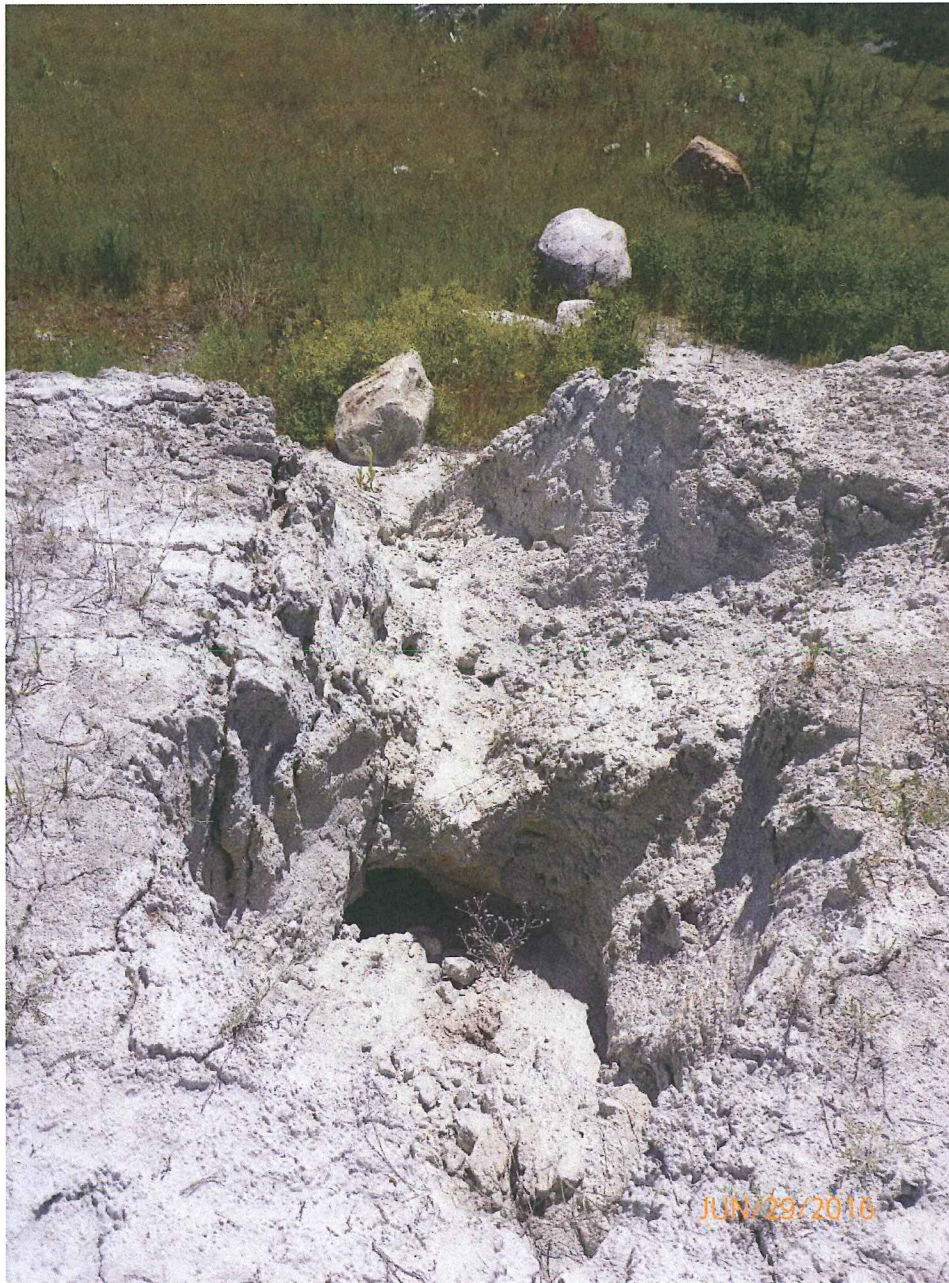
8. West Cell NW side downstream face, looking left.



9. West Cell west side downstream face, looking right. Soil movement (slumping).



10. West Cell south side downstream face, looking downstream. Erosion damage includes piping.



11. West Cell south side downstream face, looking downstream. Erosion damage includes piping.

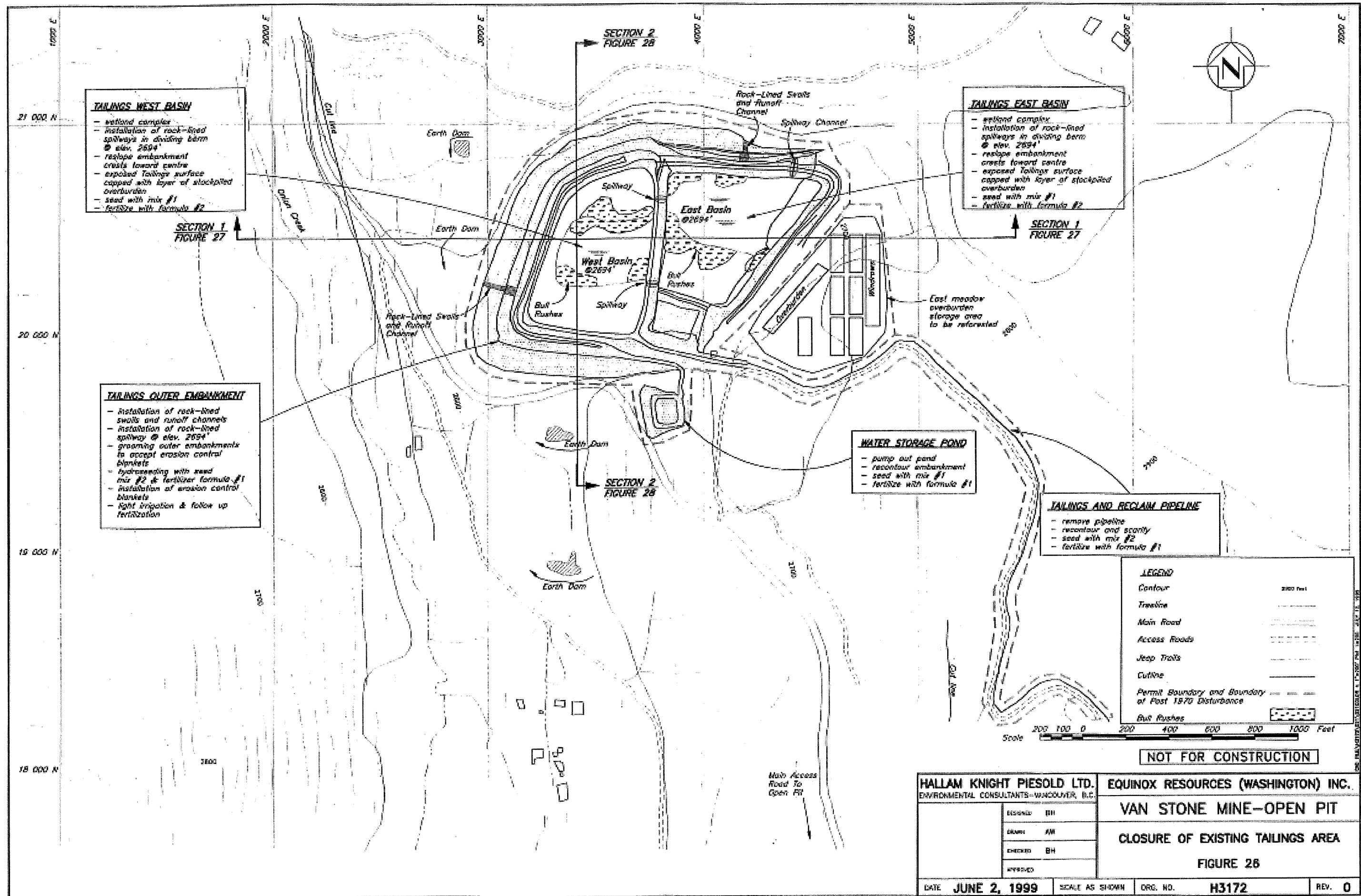


12. West Cell south side downstream face, looking right. Erosion.



13. West Cell south side downstream face, looking right (west).

Engineering Drawings



TALINGS WEST BASIN

- wetland complex
- installation of rock-lined spillways in dividing berm @ elev. 2694'
- reshape embankment crests toward centre
- exposed tailings surface capped with layer of stockpiled overburden
- seed with mix #1
- fertilize with formula #2

TALINGS EAST BASIN

- wetland complex
- installation of rock-lined spillways in dividing berm @ elev. 2694'
- reshape embankment crests toward centre
- exposed tailings surface capped with layer of stockpiled overburden
- seed with mix #1
- fertilize with formula #2

TALINGS OUTER EMBANKMENT

- installation of rock-lined swales and runoff channels
- installation of rock-lined spillway @ elev. 2694'
- growing outer embankments to accept erosion control blankets
- hydroseeding with seed mix #2 & fertilizer formula #1
- installation of erosion control blankets
- light irrigation & follow up fertilization

WATER STORAGE POND

- pump out pond
- recontour embankment
- seed with mix #1
- fertilize with formula #1

TALINGS AND RECLAIM PIPELINE

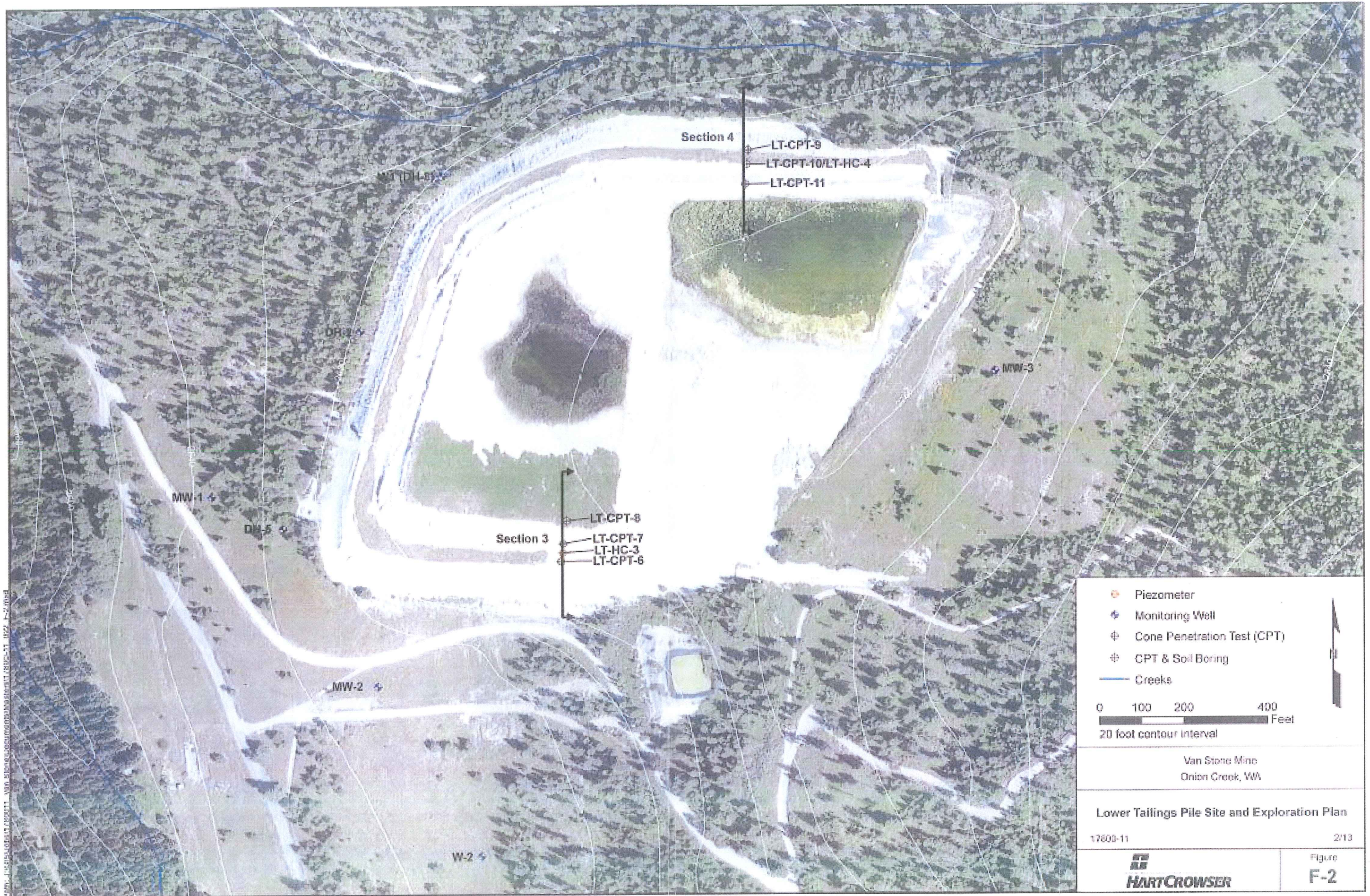
- remove pipeline
- recontour and scarify
- seed with mix #2
- fertilize with formula #1

LEGEND

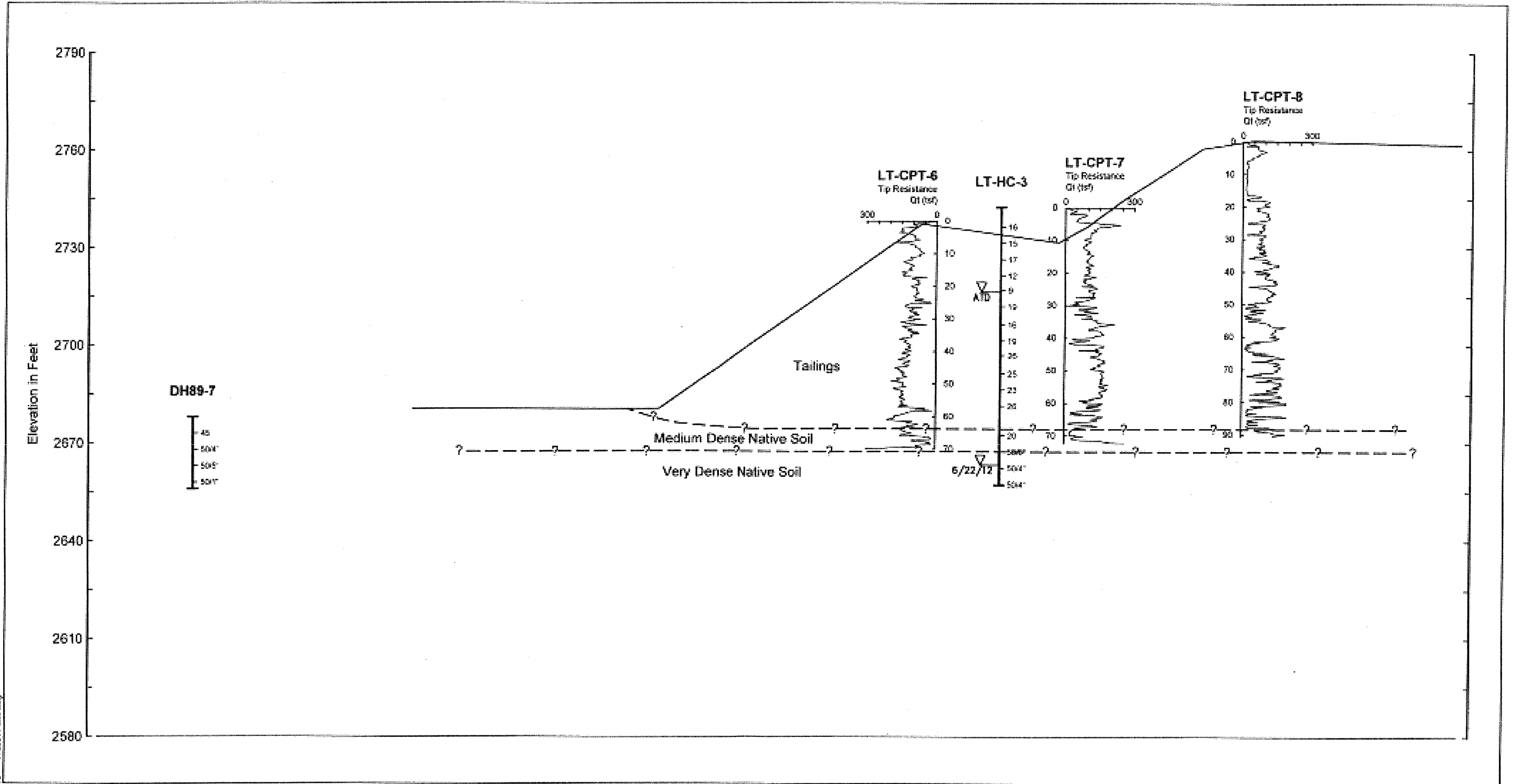
Contour	200 Feet
Tree Line	-----
Main Road	-----
Access Roads	-----
Jeep Trails	-----
Cutline	-----
Permit Boundary and Boundary of Post 1970 Disturbance	-----
Bull Rushes	-----

NOT FOR CONSTRUCTION

HALLAM KNIGHT PIESOLD LTD. ENVIRONMENTAL CONSULTANTS-WANCOUVER, B.C.		EQUINOX RESOURCES (WASHINGTON) INC.	
DESIGNED: BH		VAN STONE MINE-OPEN PIT	
DRAWN: AW		CLOSURE OF EXISTING TAILINGS AREA	
CHECKED: BH		FIGURE 26	
APPROVED:		DATE JUNE 2, 1999	SCALE AS SHOWN
		ORG. NO. H3172	REV. 0



**Generalized Subsurface Profile Along Lower Tailings Pile Cross Section 3
Van Stone Mine**



LT-HC-3 Exploration Number

LT-CPT-6 Cone Penetrometer Number

Note: Unless shown otherwise, explorations are located within 10 feet of the cross section.

Exploration Location

Cone Penetrometer Location

Standard Penetration Resistance in Blows per Foot

Water Level

0 30 60
Scale in Feet

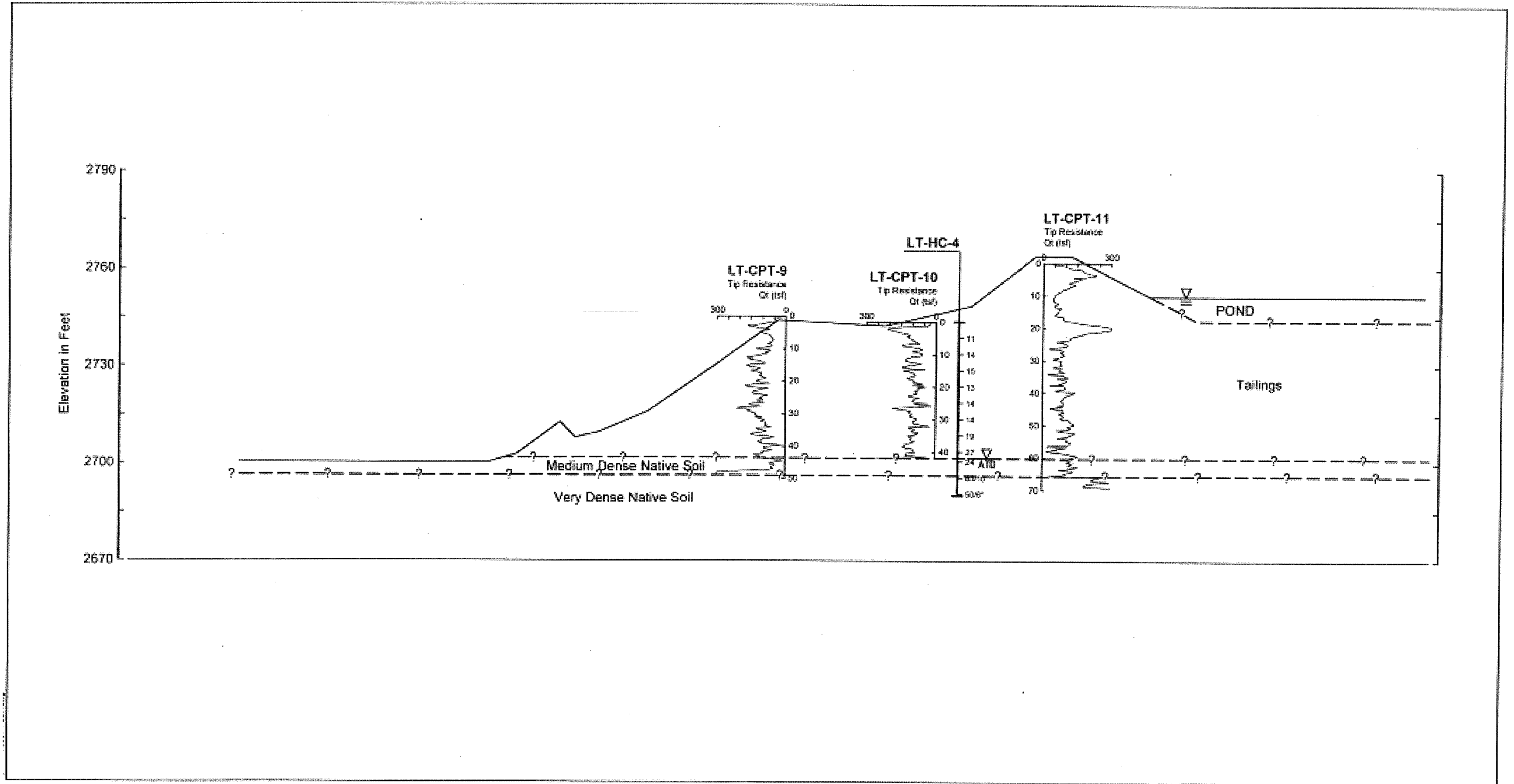
HARTCROWSER

17800-11

2/13

Figure F-5

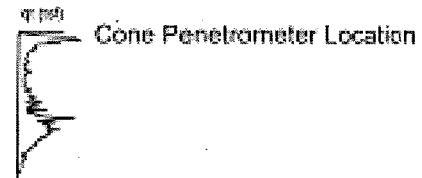
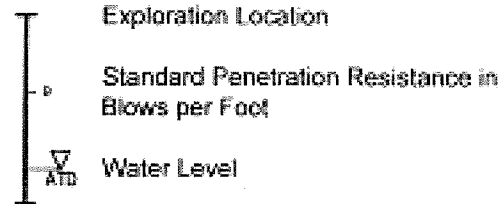
**Generalized Subsurface Profile Along Lower Tailings Pile Cross Section 4
Van Stone Mine**



LT-HC-4 Exploration Number

LT-CPT-9 Cone Penetrometer Number

Note: Unless shown otherwise, explorations are located within 10 feet of the cross section.



HARTCROWSER
17800-11 2/13
Figure F-6

Annual Inspection Form

Project Data		
Dam Name:		
Owner Name:		
Address:		Telephone No.:
Inspected by:	Date of Inspection:	Weather:

Reservoir Data
Reservoir Level at time of Inspection _____ (Drained or estimate the elevation below dam crest)
Reservoir Outflow at time of Inspection _____ (estimate water depth in inches exiting the ___ in pipe)

<p>Condition of Dam (Mark approximate location of any problem on the plan of the dam footprint on page 3 & attach photos)</p> <p>Crest: (Check for: cracks in the crushed surfacing, depressions in the surface, and evidence of burrowing animals.)</p> <p>Upstream face: (Check for: evidence of slope movement such as surface cracking and depressions, animal runs, trees and brush pioneering the slope)</p> <p>Downstream face: (Check for: wet soft areas, seepage, if seep is bubbling and carrying soil particles implement EAP.)</p>

Emergency Spillway

Low Level Inlet Pipe:

(Check for: cracking of the head wall, debris obscuring the trashrack, confirm slide gate is properly lubricated and that the gate can be operated.)

Drop Inlet:

(Check for: debris accumulating on grates of trash rack, loose or missing bolts securing grate to concrete ring, seepage at the joints or through cracks in the concrete rings of the riser, confirm vandals have not plugged the air vent pipe or thrown debris into the riser structure.)

Contra Costa Stilling Basin: (Check for: cracking of the head wall, on existing cracks note offset across the crack and the crack width)

Principal Spillway

__ inch Diam. Inlet Pipe:

(Check for: debris accumulating on the grating, proper lubrication and positioning of the canal gate)

__ inch Diam. Control Structure:

Observe confined space rules on accessing the structure.

__ inch Diam. Catch Basin & Plunge Pools:

(Check that: In the catch basin that piping is unobstructed and examine the plunge pools for erosion damage and vegetation growth that impedes their proper drainage.)

Maintenance Deficiencies

Additional Comments

Plan View

Include plan view

Photographs

Please send a copy (electronic or paper) to the Attention of the Dam Safety Office at the following address:

Washington State Dept. of Ecology
PO Box 47600
Olympia, WA 98504-7600

Note, if a problem is observed in the inspection, please call the Dam Safety Office at (360) 971-6347 24 hr pager or 407-6208 for guidance and assistance.