Mackenzie Valley Land and Water Board
7th Floor - 4910 50th Avenue • P.O. Box 2130
YELLOWKNIFE, NT X1A 2P6
Phone (867) 669-0506 • FAX (867) 873-6610

August 24, 2005

File: MV2001L2-0003

Mr. David Harpley
Environmental Coordinator
Canadian Zinc Corporation
Suite 1710-650 West Georgia Street
VANCOUVER, BC V6B 4N9

Fax: (604) 594-3855

Dear Mr. Harpley:

Board Approval – July 2005 Minewater Contingency Plan

The Mackenzie Valley Land and Water Board (the Board) met on August 24, 2005 to review the aforementioned document. The Board hereby approves the July 2005 Minewater Contingency Plan with the following conditions:

1. Canadian Zinc Corporation (CZN) shall not use chlorine in the treatment of effluents containing ammonia.
2. CZN shall take samples for external laboratory analysis to verify the accuracy of ammonia strips. The results of these tests shall be submitted to the Board.
3. CZN shall take samples for external laboratory analysis to verify the accuracy of colorimetry for zinc concentration prediction and the standards used for this methodology. The results of these tests shall be submitted to the Board.
4. An appropriately qualified Professional Engineer shall inspect the Catchment Pond dykes annually to ensure that they are stable. During times when the Catchment Pond is filled to capacity, inspections shall be carried out daily.

If you have any questions, please contact Sarah Baines at (867) 766-7457 or by email at sbaines@mvlwb.com.

Sincerely,

T. Burlingame

Todd Burlingame
Chair

Copied to: Alan Taylor, Canadian Zinc Corporation (Fax: 604-688-2043)
Distribution List

scan000.TIF

August 24, 2005

WL MV2001L2-0003

DISTRIBUTION LIST by Fax

DEHCHO/ SOUTH SLAVE AREA

FIRST NATIONS

Grand Chief Herb Norwegian	Dehcho First Nations	35	867-695-2038
Chief Keyna Norwegian	Liidlii Kue First Nation (Ft Simpson)	25	867-695-2665
Chief Berna Landry	Deh Gah Got'ie Dene Council (Ft Prov.)	18	867-699-3210
Chief Floyd Bertrand	Acho Dene Koe First Nation (Fort Liard)	37	867-770-4144
Chief Eric Betsaka	Nahanni Butte First Nation	36	867-602-2910
Chief David Moses	Pehdzeh Ki First Nation (Wrigley)	23	867-581-3229
Chief Fred Norwegian	TthedzehK'edeli First Nation (JMR)	22	867-809-2002 or 809-2071
Chief Lloyd Chicot	Ka'a'gee Tu First Nation (Kakisa)	21	867-825-2002
Chief Dennis Deneron	Sambaa K'e Dene Band (Trout Lake)	38	867-206-2828
Chief Roy Fabian	K'atlodeeche First Nation (Hay River)	20	867-874-3229
Chief Karen Felker	West Point First Nation (Hay River)	19	867-874-2486

COMMUNITIES

Mayor Maggie Levavasseur	Hamlet of Fort Providence	18	867-699-3210
Mayor Diane Gonet	Hamlet of Fort Liard	39	867-770-4004
Mayor Raymond Michaud	Village of Fort Simpson	17	867-695-2005
Mayor Diana Ehman	Town of Hay River	16	867-874-3237
Mayor Winnie Cadieux	Enterprise Settlement Corporation	24	867-984-3400

ABORIGINAL ORGANIZATIONS

Laura Pitkanen	Dehcho Representative		705-756-4466
Heidi Wiebe	Deh Cho Land Use Planning Committee	41	867-699-3166
Chris Paci	Dene Nation	40	920-2254
President Dana Cross	Hay River Metis Nation		867-874-6888
President Danny Beck	Hay River Métis Council		867-874-4472
President Ernie McLeod	Fort Liard Métis Local #67	42	867-770-3266
President Albert Lafferty	Fort Providence Métis Council #57		867-699-4319
President Marie Lafferty	Fort Simpson Métis Local #52		867-695-2040
President Robert Tordiff	Northwest Territory Métis Nation	45	867-872-2772
Frank Kotchea	Nahendeh Land & Environmental Services	43	867-770-4573

GOVERNMENT

Ed Hornby	South Mackenzie District Office	57	669-2720
Kathleen Racher	INAC – Water Resources	58	669-2716
Mineral Development Advisor	Mineral Development Division	59	669-2705
Tom Andrews	GNWT - Prince of Wales Heritage Museum	60	873-0205
Mark Davy	GNWT - MACA	62	920-6343
Duane Fleming	GNWT - Health	65	669-7517
Jason McNeill	GNWT - ENR	63	873-4021
Michael Brown	GNWT - DOT	64	920-2565
Mike Fournier	Environment Canada	66	873-8185
Ernest Watson	DFO	68	669-4940
Josephine Simms	WCB	67	873-4596

If there is an error in our contact, please notify our office.

Mackenzie Valley Land and Water Board
7th Floor - 4910 50th Avenue
P.O. Box 2130
YELLOWKNIFE NT X1A 2P6
Phone (867) 669-0506
FAX (867) 873-6610

Staff Report

Company: Canadian Zinc Corporation (CZN)	
Location: Prairie Creek Mine	**Application:** MV2001L2-0003
Date Prepared: August 9, 2005	**Meeting Date:** August 24, 2005
Subject: Plan approval – Minewater Contingency Plan	

1. Purpose/Report Summary

The purpose of this staff report is to present to the Board for review and approval the Prairie Creek Minewater Contingency Plan (MCP) submitted by Canadian Zinc Corporation (CZN).

2. Background

Part D, item 12 of Water Licence MV2001L2-0003 requires that CZN submit a MCP to the Board for approval:

> *"The Licensee shall, sixty (60) days prior to the commencement of pumping Minewater from the decline, submit to the Board for approval a Minewater Contingency Plan. The plan shall include contingencies for the treatment of Minewater in the event it does not meet discharge criteria and there is a risk of the Minewater exceeding the Polishing Pond freeboard limit."*

Chronology

May 12, 2004: Receipt of the MCP.

June 30, 2004: MCP distributed for review. Deadline for comments set at August 20, 2004.

September 14, 2004: Letter sent to CZN requesting that CZN address a number of points raised by reviewers. The deadline for CZN's response was set at October 22, 2004.

September 27, 2004: Board staff requested that CZN hold off on revising the MCP until further information is provided to the company by Board staff. This information further defined what is required in the MCP.

October 7, 2004: Letter sent to CZN containing further information about the requirements of the MCP. New deadline for CZN's response to reviewers and revised MCP set at November 17, 2004.

November 22, 2004: Receipt of CZN's response to reviewer comments and revised MCP.

January 4, 2005: Revised MCP distributed for review. Deadline for comments set at February 18, 2005.

February 15, 2005: Extension for review period of the revised MCP granted. New deadline for comments set at March 10, 2005.

June 16 and 22, 2005: Letters sent to CZN requesting that the company respond to a number of questions raised by reviewers during the review of the revised MCP. The deadline for this response set at July 8, 2005.

July 5, 2005: Receipt of CZN's response to reviewer's comments on the revised MCP. Along with their response, CZN also submitted an updated MCP (July 2005 MCP).

June 22, 2005: July 2005 MCP distributed to reviewers.

August 24, 2005: Board meeting.

3. Discussion

Parks Canada raised concerns about the size of the Polishing Pond, the final structure in the water treatment pathway at the Prairie Creek Mine. The Board will have another opportunity to review and approve the Polishing Pond prior to its use. Part D, item 7 of the Licence requires that CZN submit to the Board for approval a geotechnical assessment carried out by a Geotechnical Engineer of the integrity and capacity of the Polishing Pond. However, if the Board chooses to consider this concern during the review of the MCP, the following discussion provides background information.

Parks Canada is of the opinion that the Polishing Pond should be large enough to accommodate a flow rate of 1.0 m^3/min from the 870 m portal in order to incorporate the worst case scenario into the MCP. Water flows from the 870 m portal freely under gravity.

The flow rate of 1.0 m^3/min provided by Parks Canada comes from a report released by Water Resources Division, INAC in 2002 titled, *"Historical Water Quality of the Prairie Creek Project Area"*. The following is an excerpt from page 10 of that report (for reference this report in its entirety is attached to this Staff Report):

Visual estimates of the flow of minewater [from the 870 m portal] were made by inspectors when the site was active in the 1980's. A review of the files found no further estimates of flow until the most recent documentation from Canadian Zinc. These estimates were all made using best professional judgement; as such, the utility of these estimates is limited. Actual flow measurements would be more useful in determining the environmental impact of the minewater discharge. The most recent data (CZN, 2001c) provided by the company are stated to be preliminary results of daily flow monitoring from the 2001 summer season, but the full extent of this work hasn't been reviewed.

The modified list of flow rates from the 870 m portal from greatest to least (blue estimates were done visually by the Inspector and the red estimates are actual measured rates from CZN):

CZN proposes to Construct the polishing Pond to accommodate flows of 0.360 m^3/min. (arrow pointing to June 27, 1983)

Date	Estimated Volume	Source
August 23, 1983	1.000 m^3/min	Inspector
June 27, 1983	0.500 m^3/min	Inspector
May 25, 1984 3	0.300 m^3/min	Inspector
February 2, 1982	0.273 m^3/min	Inspector
May 12, 1982	0.267 m^3/min	Inspector
April 1981	0.228 m^3/min	W. Bryant (EPS)
August 27, 1982	0.100 m^3/min	Inspector
September 28, 1983	0.100 m^3/min	Inspector
CZN 2001c	0.080 m^3/min	CZN
May 20, 1981	0.068 m^3/min	Inspector
Site visit, 2001	0.060 m^3/min	CZN
April 30, 1981	0.045 m^3/min	Inspector

As indicated above with the grey arrow, CZN plans to construct the Polishing Pond to accommodate larger flows, although not the largest flow. Parks Canada disagrees with this and prefers that CZN construct the Polishing Pond to accommodate the largest flow. However, it must be noted that the DIAND report itself acknowledges that the *"utility of these estimates is limited"*. The flow rate selected by CZN is well above the actual measured estimates shown in red, which are more reliable.

Parks Canada also raised concerns about the proposed freeboard of 0.5 m for the Polishing Pond. Freeboard has to be maintained to the satisfaction of the Inspector rather than to a specified limit under the Licence (part D, item 14). Board staff has discussed the design of the Polishing Pond with the Inspector and the Inspector's preliminary thoughts are that although 1 m freeboard is preferable, there is limited room at the site for a larger Pond. Increasing the size of the Polishing Pond may decrease the distance between it and Prairie Creek, which has associated environmental risk as well.

4. Comments

During a telephone conversation with Board Staff, Kathleen Racher of Water Resources Division, INAC indicated that the MCP is thorough, sound and feasible.

5. Review Comments and Company Responses

Please see the attached Comment Summary Table for review comments and CZN's responses to the comments.

Board staff recommends that the following four commitments made by CZN in their responses to review comments be made conditions of the approval of the MCP:

a) CZN shall not use chlorine in the treatment of effluents containing ammonia.
b) CZN shall take samples for external laboratory analysis to verify the accuracy of ammonia strips. The results of these tests should be submitted to the Board.
c) CZN shall take samples for external laboratory analysis to verify the accuracy of colorimetry for zinc concentration prediction and the standards used for this methodology. The results of these tests should be submitted to the Board.
d) CZN shall inspect the Catchment Pond dykes annually for stability and condition. Board staff recommends that the inspections be done daily if the Catchment Pond is filled to capacity.

6. Security

Not applicable.

7. Conclusion

All review comments have been satisfactorily addressed.

8. Recommendations

I recommend that the requirements of part D, item 12 be considered satisfied and that the July 2005 MCP be approved. This approval should be conditional upon CZN fulfilling their commitments outlined in points (a) to (d) under the Review Comments and Company Responses section of this Staff Report.

9. Attachments

- Comment Summary Table
- Map of the Prairie Creek Mine site
- July 2005 MCP
- Report titled, "*Water Quality of the Prairie Creek Project Area*" (INAC 2002)

Respectfully submitted,

S Baines

Sarah Baines
Regulatory Officer

Comment Summary Table
Prairie Creek Minewater Contingency Plan

Reviewing Agency, Date Comments Received	Comments	Company Response *(Board staff comments in red italics)*
Parks Canada, February 17, 2005	1. How often is the Polishing Pond discharge to be sampled? How much water can potentially be discharged into Harrison Creek before the gate weir is raised, and for how long can the gate be raised before overflowing begins? What are the alternatives to this, i.e. can a gate weir be placed at the Polishing Pond point of discharge?	1. This is specified in the Water Licence (under SNP) – weekly during operations and twice during the summer after operations have ceased. *Comment addressed. Please see Company Response under INAC, bullet 2 for further information*
	2. CZN states they will seek to avoid elevated ammonia concentrations by "ensuring the proper handling and housekeeping with respect to explosive use underground." What are the proper handling and housekeeping techniques to be used specifically? CZN also mentions that a sump near the site of blasting will be monitored for ammonia. How frequently will this sump be sampled and for how long after the blasting period?	2. The preferred explosive for Decline development is ammonium nitrate – fuel oil (ANFO). Ammonium nitrite can be acquired in dry, prill form in 20 kg bags. A small batching station would be established in the mine area where each bag of prill is emptied into a container, mixed with 1-1.2 L of fuel oil, and then re-bagged. The bags of ANFO would then be taken underground to the blasting area. The bags would be emptied into a larger container, the ANFO loader. The loader has a pneumatic pump which blows the ANFO into the blast-holes via a flexible hose. Care is taken to avoid 'blow-back' and ANFO spillage. Any spillage is collected. Any residual ANFO in the loader after charging is re-bagged and hauled out to the explosives magazine. The sump nearest the blasting face will be tested for ammonia as soon as it is safe to enter the area after blasting. Depending on how far the sump is from the face and the velocity of flow, sampling will be repeated in order to test the early arrival of drainage immediately after the blast. Thereafter, sampling will occur approximately every 30 minutes and continue until confidence is gained that the drainage does not contain ammonia. *Comment addressed.*
	3. There are no details relating to the Surveillance Network Program describing the locations,	3. This information is also given in the Water Licence (under SNP). The sampling frequency and analytical parameter

<table>
<tr>
<td></td>
<td>parameters to be analyzed, frequency of the analysis, and the regulatory requirement for each parameter. One comment that refers to site-specific sampling states: "The quality of the minewater from the new 905m sump (SNP Station No. 3-2…) as well as minewater on the 870m level… (SNP Station No. 3-7), will be monitored at least monthly as required." These two stations, according the SNP outlined in Water Licence MV2001L2-003 must be sampled at least weekly.

<u>Comments related to the Polishing Pond</u>

4. Parks Canada recommends CZN incorporate all flow estimates recorded for the 870m portal discharge. Based on the July 2002 DIAND report (Historical Water Quality of the Prairie Creek Project Area), the design flow for water management planning should be 1.0 m^3/min (16.7 L/sec) in order to incorporate any worst case scenario into the minewater contingency plan.

The Polishing Pond dimensions, therefore, should be increased in size to account for a worst case scenario volume capacity. Even using the flow rates the company put forth as inputs to the Polishing Pond, there is discrepancy between the figures in the water balance and the actual capacity of the Polishing Pond:

Excess process water: 0.00042 m^3/sec
Mine water 870 decline: 0.006 m^3/sec
Mine water 905 decline: 0.007 m^3/sec
Total: 0.0134 m^3/sec
Over a 24-hour period, this amounts to 1160 m^3.

The Polishing Pond only has a capacity of 1440 m^3, based on a freeboard of 0.5 metres (12 m x 60 m x 2 m). If the freeboard was to be actually 1 metre, the capacity of the Polishing Pond was further reduced to 1080 m^3. The inputs from the</td>
<td>information will be given in table format, and sampling locations shown on a figure, in the revised MCP. Comment addressed. Please see Table 3 on page 24 of the MCP

4. Please see the Discussion Section of the Staff Report.</td>
</tr>
</table>

	processing activities and the declines would exceed the capacity of the Polishing Pond in less than 24 hours. This calculation did not include any contributions from rainfall events or more significantly, from the spring freshet. CZN states that there is sufficient area available to enlarge the pond if necessary to accommodate a larger flow. How can the pond be enlarged and properly lined after the fact if it is already filled with water? It seems it would be more appropriate if the pond was built to the appropriate size initially.	
Dehcho First Nations, February 18, 2005	1. The Dehcho First Nations have serious concerns with the current water Licence MV2001L20003, as issued by the Board. These issues include water treatment contingencies. As the Dehcho First Nations concerns are being addressed outside the Board's regulatory process, we are not submitting comments on the Minewater Treatment Contingency Plan recently provided by CZN.	1. *Comment provided to the Board.*
INAC, February 28, 2005	1. Sufficient background on the project, the water sources, and the water management plan is provided to facilitate a thorough review of the Plan. The Plan is generally sound and lists numerous feasible contingencies. 2. For both the water quality and excess water contingency plans, closing of the gate weir on the Catchment Pond is proposed. More detail about the ability of the gate weir to prevent discharge should be provided. For example, if the Polishing Pond is at capacity or there is a sudden increase in minewater flow and the Catchment Pond reaches capacity (5,000 m^3), will closing the gate weir guarantee that no water flows from the Catchment Pond, or can water flow over the sides of the pond? What is the capacity of the pond with the gate weir closed?	1. *Comment provided to Board.* 2. The gate weir consists of a shutter that slides vertically in two metal guide rails which are positioned over the end of a horizontal decant pipe. The shutter can be positioned to prevent discharge almost completely (there is minor leakage around the sides of the shutter within the metal guides), or to allow discharge subject to a selected pond water level. *Comment addressed.*

	3. The Plan indicates that chemical treatment could occur in the Polishing Pond. If this is a contingency then it should be listed in Section 4.0 (Contingency Plan – Water Quality). This would clarify when chemical treatment in the pond would occur, relative to the other contingencies.	3. Despite CZN's best monitoring efforts, it is possible that minewater with elevated metal concentrations may discharge from the treatment sump to the Polishing Pond. If this occurs, CZN will have four options: • pump treatment sump discharge to an up-gradient sump, thus stopping inflow to and outflow from the Polishing Pond; • pump Polishing Pond outflow to mine sumps; • pump either treatment sump or Polishing Pond outflow to the Mill; and, • add soda ash to the Polishing Pond to raise pH. Some of these options could be used in combination. If there was a problem with dosing in the treatment sump such that pH was not kept elevated, there may be a marginal increase in metals concentrations in the Polishing Pond. Soda ash addition to the pond would rectify this, perhaps in combination with recirculation of treatment sump outflow to allow greater residence time in the pond. This contingency will be added to Section 4.0 in the MCP. *Comment addressed.*
	4. If hydrocarbons in the Polishing Pond exceed the Licence limit, what is the contingency plan?	4. If petroleum hydrocarbons are present in the Polishing Pond, they will most likely be in the form of floating fuel, perhaps from a diesel spill or leak. In this event, CZN maintains adsorbent booms and other spill response equipment at several locations around the site, and would deploy these to collect the fuel. In the unlikely event that the water in the pond itself has dissolved petroleum hydrocarbon concentrations exceeding Licence limits, CZN will use a portable activated carbon vessel to remove the hydrocarbons from pond discharge prior to the Catchment Pond. *Comment addressed.*
	5. The plan states that "in the event that water volumes are continuously greater than expected, pumps and water management facilities would be upgraded". How would this occur?	5. In the event that minewater flows are continuously greater than expected, CZN will install larger or multiple pumps, and if necessary, expand the capacity of storage sumps and polishing. If additional sump capacity is needed, it will be relatively easy to enlarge existing sumps or create new ones underground by drilling and blasting. The existing treatment sump is quite large, and is unlikely to need enlargement. Higher flows will mean a greater soda ash

		demand to increase pH, which will be supplied by the ph controlled, metered dosing system. If additional polishing capacity is required, CZN will build a secondary Polishing Pond before the Catchment Pond. *Comment addressed.*
	6. Numerous tanks (e.g., concentrate and reagent stock tanks) will be used for additional storage, if necessary. Are these tanks currently clean or is there potential for water contamination from tank residues?	6. The tanks are clean, they have never been used. There is no potential for contamination of minewater from tank residues. *Comment addressed.*
	7. The plan indicates that approximately half of the capacity of one of the thickeners (which has a 270 m^3 capacity) will be half-full with tailings and process water. Assuming a 50/50 split between tailings and process water, this means that approximately 68 m^3 of tailings are expected in the thickener. How does this compare to the expected volume of tailings to be produced during the 6 months of pilot plant operation?	7. CZN's plan was to mine 1,000-2,000 tonnes of vein material for processing in the Pilot Plant. If 2,000 tonnes are processed, approximately 800-900 tonnes of tailings would be generated. The specific gravity of the tails will be in the range 1.6-1.8 tonnes/m^3. Assuming 850 tonnes at 1.7 tonnes/m^3 equates to 500 m^3 of tails. Therefore, CZN's plan would result in the filling of at least one of the thickener tanks with tailings, may be both, unless tailings are removed during the operating period to a final disposal location based on an approved final tailings disposal plan. It would be feasible to store all of the tailings in the thickener tanks for later remobilization and disposal. *Comment addressed.*
	8. The Plan indicates that if there is a sudden unexpected in-rush of groundwater from underground, the water could be directed to the Catchment Pond directly, omitting the Polishing Pond. It should be noted that this would put the Company out of compliance with Part D, Section 4 of the water Licence.	8. CZN is aware that direct discharge to the Catchment Pond bypassing the Polishing Pond raises the issue of compliance. Firstly, this is very unlikely to happen because minewater flows are not strongly influenced by storm events. Also, a sudden in-rush of water underground, if it occurred, would occur during decline development, in which case the in-rush would have to first flood the decline and then spill into the rest of the workings. Secondly, direct discharge to the Catchment Pond would only be allowed if CZN is confident that Licence criteria can be met (the water would be sampled to confirm this). If CZN is not confident that direct discharge to the Catchment Pond would meet Licence criteria but has no choice, the gate weir on the Catchment Pond will be closed until confirmation is obtained that the quality of the water is acceptable for discharge. *Comment addressed.*

Environment Canada March 11, 2005	1. The main outstanding concern lies with the proposed use of chlorine for the treatment of ammonia. This is unacceptable, as ammonia and chlorine combine to form inorganic chloramines, which are listed on the List of Toxic Substances in Schedule 1 of the Canadian Environmental Protection Act. (Further information is available at the following website: http://www.ec.gc.ca/substances/ese/eng/psap/final/chloramines.cfm). Inorganic chloramines consist of three chemicals that are formed when chlorine and ammonia are combined in water: mono-chloramine (NH_2Cl), dichloramine ($NHCl_2$) and trichloramine (NCl_3). There would almost certainly still be unacceptable amounts remaining after treatment with granular activated carbon (which may reduce concentrations by only an order of magnitude); the guideline recommended for the protection of aquatic life is 0.5 ug/L. Accordingly, EC does not feel this is a viable alternative or contingency for ammonia treatment.	1. As stated in the November 2004 draft MCP, there is a potential for ANFO spillage as blast holes are charged, and for misfires or incomplete detonation during blasting. CZN will seek to avoid elevated ammonia concentrations in mine water by the following actions: • Minimizing explosive use by reducing powder factors to the minimum required to achieve effective blasting; and, • Ensuring proper handling and housekeeping with respect to explosive use underground (to minimize and clean-up spills). If a positive indication of ammonia presence in drainage from the blasting area is indicated by the use of ammonia strips, the water will be pumped to the Mill for temporary storage. This will enable volatilization of un-ionized ammonia (NH_3), and oxidation and biological nitrification of ammonia to less toxic nitrate. Given the concern with respect to chlorine addition and the formation of chloramines, chlorine will not be used. The water will be kept in the Mill until testing indicates the water can be returned to the mine for metals treatment. When this is done, the pumping rate will be low so that the water is blended with minewater judged to be free of ammonia as a further contingency. *Comment addressed. Prohibiting the use of chlorine to treat ammonia should be a condition of the approval of the MCP.*
	2. Treatment for metals removal will have to be controlled such that pH is not raised above 9.5 in final discharge.	2. CZN is aware that the discharge pH needs to be below 9.5. CZN intends to set the soda ash dosing to a target pH of 9.5. CZN is confident that this will be sufficient to satisfactorily remove metals, and render the final discharge from the Polishing Pond less than 9.5 due to alkalinity consumption along the flow path. *Comment addressed.*
	3. The use of ammonia detection strips should be validated for accuracy with concurrent lab analyses for a range of ammonia concentrations.	3. The ammonia strips that will be used detect in the range 0.2-10 mg/L. CZN intends to use these for ammonia detection, not for the precise estimation of ammonia

		content. Any detection will trigger the contingency approach for managing ammonia in minewater. Similarly, after storage in the Mill, the water must pass the detection test before it will be returned underground. In addition, CZN will take samples for external laboratory analysis to verify the accuracy of this approach. *Comment addressed. Taking samples for external laboratory analysis to verify the accuracy of this approach should be a condition of the approval of the MCP.*
	4. Colorimetric zinc analysis should also be checked through lab analyses of samples over a range of zinc concentrations.	4. CZN will take samples for external laboratory analysis to verify the accuracy of the colorimetry for zinc concentration prediction, and the accuracy of the standards used for this. *Comment addressed. Make this a condition of approval of the MCP.*
	5. The Plan notes the option of recirculating drill water as a contingency – why wouldn't this be routinely done as a water conservation measure?	5. Water for drilling is usually obtained from the nearest sump to the working face. By design, drainage from the face reports to the sump and then overflows to the adit. Therefore, drill water is recirculated when drilling is in progress. *Comment addressed.*
	6. Stability of the Catchment Pond will have to be established, to ensure that raising the water levels will not result in instability once banks and berms are saturated.	6. The Catchment Pond has substantial storage capacity. Even with the water level at the top of the discharge pipe, there would still be a freeboard in excess of 0.5 m. CZN has operated the pond for many years, and pond levels have never approached the crest or any elevation where instability might occur. The dykes are also inspected annually for stability and condition, and no concerns have been noted with respect to the Catchment Pond. *Comment addressed. Part D, item 13 of the Licence requires that CZN install and maintain a discharge control structure in the Catchment Pond to the satisfaction of an Inspector. Annual inspections of the dykes should be a condition of approval of the MCP.*
	7. Potential contaminants of concern should include suspended solids; these will be addressed by settling and possibly flocculation.	7. One of the reasons the decision was taken to treat minewater underground was to preserve the Polishing Pond for settling only, during normal operating conditions. This is expected to polish the water such that suspended matter

		and total metals will be at a minimum in the discharge. As stated in the draft MCP, flocculants will be used if the desired settling is not achieved because particles are too small. *Comment addressed.*

CANADIAN ZINC CORPORATION

July 5, 2005 **Fax 867-873-6610**

Ms. Sarah Baines
Regulatory Officer
Mackenzie Valley Land and Water Board
7th Floor-4910 50th Avenue,
Yellowknife, NT
X1A 2P6

Dear Ms. Baines:

RE: Minewater Contingency Plan, MV2001L2-0003

We are in receipt of your letters dated June 15 and June 22, 2005 regarding Canadian Zinc's (CZN) November 2004 Minewater Contingency Plan for the Pilot Plant and Underground Decline Exploration and Development Projects at the Prairie Creek Mine. This letter provides the further information requested in your letters. Our responses are provided according to the numbered items in your June 15 and June 22, 2005 letters, in that order.

1. *Provide more detail about the ability of the gate weir to prevent discharge (i.e. describe what it looks like and how it operates). For Example, if the Polishing Pond is at capacity or there is a sudden increase in minewater flow, will closing the gate weir prevent or just slow water flow from the Catchment Pond.*

The gate weir consists of a shutter that slides vertically in two metal guide rails which are positioned over the end of a horizontal decant pipe. The shutter can be positioned to prevent discharge almost completely (there is minor leakage around the sides of the shutter within the metal guides), or to allow discharge subject to a selected pond water level.

2. *In section 2.2.2 of the MCP, chemical treatment in the Polishing Pond may occur if necessary. Include this in Section 4.0 (Contingency Plan – Water Quality) to clarify when chemical treatment in the Polishing Pond would occur relative to other contingencies.*

Despite CZN's best monitoring efforts, it is possible that minewater with elevated metal concentrations may discharge from the treatment sump to the Polishing Pond. If this occurs, CZN will have four options:

- pump treatment sump discharge to an up-gradient sump, thus stopping inflow to and outflow from the Polishing Pond;
- pump Polishing Pond outflow to mine sumps;
- pump either treatment sump or Polishing Pond outflow to the Mill; and,
- add soda ash to the Polishing Pond to raise pH.

Some of these options could be used in combination. If there was a problem with dosing in the treatment sump such that pH was not kept elevated, there may be a marginal increase in metals concentrations in the Polishing Pond. Soda ash addition to the pond would rectify this, perhaps in combination with recirculation of treatment sump outflow to allow greater residence time in the pond. This contingency will be added to Section 4.0 in the MCP.

3. *Provide contingency plans for dealing with hydrocarbon concentrations that exceed license limits in the Polishing Pond.*

If petroleum hydrocarbons are present in the Polishing Pond, they will most likely be in the form of floating fuel, perhaps from a diesel spill or leak. In this event, CZN maintains adsorbant booms and other spill response equipment at several locations around the site, and would deploy these to collect the fuel. In the unlikely event that the water in the pond itself has dissolved petroleum hydrocarbon concentrations exceeding license limits, CZN will use a portable activated carbon vessel to remove the hydrocarbons from pond discharge prior to the Catchment Pond.

4. *In Section 3.1 (Contingency Plan: Excess Water – Normal Operating Conditions), clarify how pumps and the water management facilities would be upgraded in the event that water volumes are continuously greater than expected (e.g. would the capacity of the sumps/Polishing Pond be increased by building berms around the structures? Would those berms then be lined?).*

In the event that minewater flows are continuously greater than expected, CZN will install larger or multiple pumps, and if necessary, expand the capacity of storage sumps and polishing. If additional sump capacity is needed, it will be relatively easy to enlarge existing sumps or create new ones underground by drilling and blasting. The existing treatment sump is quite large, and is unlikely to need enlargement. Higher flows will mean a greater soda ash demand to increase pH, which will be supplied by the ph-controlled, metered dosing system. If additional polishing capacity is required, CZN will build a secondary polishing pond before the Catchment Pond.

5. *In Section 3.2 (Contingency Plan: Excess Water – Abnormal Operating Conditions), clarify whether or not the tanks inside the Mill (concentrate and reagent stock tanks) are currently clean. Is there the potential for contamination from tank residues that will then require further treatment to remove?*

The tanks are clean, they have never been used. There is no potential for contamination of minewater from tank residues.

6. *Section 3.2 (Contingency Plan: Excess Water – Abnormal Operating Conditions), indicates that approximately half of the capacity of one of the thickeners (which has a 270 m^3 capacity) will be half full with tailings and process water. Assuming a 50/50 split between tailings and process water, this means that approximately 68 m3 of tailings are expected in the thickener. How does this compare to the expected volume of tailings to be produced during the entire 6 month run of the pilot plant operation?*

CZN's plan was to mine 1,000-2,000 tonnes of vein material for processing in the Pilot Plant. If 2,000 tonnes are processed, approximately 800-900 tonnes of tailings would be generated. The specific gravity of the tails will be in the range 1.6-1.8 tonnes/m^3. Assuming 850 tonnes at 1.7 tonnes/m^3 equates to 500 m^3 of tails. Therefore, CZN's plan would result in the filling of at least one of the thickener tanks with tailings, may be both, unless tailings are removed during the operating period to a final disposal location based on an approved final tailings disposal plan. It would be feasible to store all of the tailings in the thickener tanks for later remobilisation and disposal.

7. *Section 3.2 of the MCP states that water could be directed to the Catchment Pond directly, bypassing the Polishing Pond. Please note that this would put the company out of compliance with Part D, Section 4 of the Water License if the water did not meet license criteria in Part D, item 5.*

CZN is aware that direct discharge to the Catchment Pond bypassing the Polishing Pond raises the issue of compliance. Firstly, this is very unlikely to happen because minewater flows are not strongly influenced by storm events. Also, a sudden in-rush of water underground, if it occurred, would occur during decline development, in which case the in-rush would have to first flood the decline and then spill into the rest of the workings. Secondly, direct discharge to the Catchment Pond would only be allowed if CZN is confident that license criteria can be met (the water would be sampled to confirm this). If CZN is not confident that direct discharge to the Catchment Pond would meet license criteria but has no choice, the gate weir on the Catchment Pond will be closed until confirmation is obtained that the quality of the water is acceptable for discharge.

8. *Provide alternative contingency measures for the treatment of ammonia as the one proposed in the MCP is unacceptable. Ammonia and chlorine combine to form inorganic chloramines, which are listed on the List of Toxic Substances in Schedule 1 of the Canadian Environmental Protection Act.*

As stated in the November 2004 draft MCP, there is a potential for ANFO spillage as blast holes are charged, and for misfires or incomplete detonation during blasting. CZN will seek to avoid elevated ammonia concentrations in mine water by the following actions:

- Minimizing explosive use by reducing powder factors to the minimum required to achieve effective blasting; and,
- Ensuring proper handling and housekeeping with respect to explosive use underground (to minimize and clean-up spills).

If a positive indication of ammonia presence in drainage from the blasting area is indicated by the use of ammonia strips, the water will be pumped to the Mill for temporary storage. This will enable volatilization of un-ionized ammonia (NH_3), and oxidation and biological nitrification of ammonia to less toxic nitrate. Given the concern with respect to chlorine addition and the formation of chloramines, chlorine will not be used. The water will be kept in the Mill until testing indicates the water can be returned to the mine for metals treatment. When this is done, the pumping rate will be low so that the water is blended with minewater judged to be free of ammonia as a further contingency.

9. *Please note that treatment for metals removal will have to be controlled such that pH is not raised above 9.5 in the final discharge.*

CZN is aware that the discharge pH needs to be below 9.5. CZN intends to set the soda ash dosing to a target pH of 9.5. CZN is confident that this will be sufficient to satisfactorily remove metals, and render the final discharge from the Polishing Pond less than 9.5 due to alkalinity consumption along the flow path.

10. *Please note that the use of ammonia detection strips should be validated for accuracy with concurrent lab analyses for a range of ammonia concentrations.*

The ammonia strips that will be used detect in the range 0.2-10 mg/L. CZN intends to use these for ammonia detection, not for the precise estimation of ammonia content. Any detection will trigger the contingency approach for managing ammonia in minewater. Similarly, after storage in the Mill, the water must pass the detection test before it will be returned underground. In addition, CZN will take samples for external laboratory analysis to verify the accuracy of this approach.

11. *Please note that colorimetric zinc analysis should be checked through lab analyses of samples over a range of zinc concentrations.*

CZN will take samples for external laboratory analysis to verify the accuracy of the colorimetry for zinc concentration prediction, and the accuracy of the standards used for this.

12. *Clarify whether or not recirculating drill water will be routinely done as a water conservation measure and not just as a contingency measure.*

Water for drilling is usually obtained from the nearest sump to the working face. By design, drainage from the face reports to the sump and then overflows to the adit. Therefore, drill water is recirculated when drilling is in progress.

13. *Stability of the Catchment Pond will have to be established, to ensure that raising the water levels will not result in instability once banks and berms are saturated.*

The Catchment Pond has substantial storage capacity. Even with the water level at the top of the discharge pipe, there would still be a freeboard in excess of 0.5 m. CZN has operated the pond for many years, and pond levels have never approached the crest or any elevation where instability might occur. The dikes are also inspected annually for stability and condition, and no concerns have been noted with respect to the Catchment Pond.

14. *Potential contaminants of concern should include suspended solids; these will be addressed by settling and possibly flocculation.*

One of the reasons the decision was taken to treat minewater underground was to preserve the Polishing Pond for settling only, during normal operating conditions. This is expected to polish the water such that suspended matter and total metals will be at a minimum in the discharge. As stated in the draft MCP, flocculants will be used if the desired settling is not achieved because particles are too small.

15. *On page 14 at the top, it appears that the word 'development' should be 'decrease'. Revise as necessary.*

Correct. Done.

1. *Provide details on how often the Polishing Pond will be sampled.*

This is specified in the Water License (under SNP) – weekly during operations and twice during the summer after operations have ceased.

2. *Provide details on the storage and handling techniques for explosives that will be used to help minimize ammonia concentrations in water emanating from the underground works.*

The preferred explosive for Decline development is ammonium nitrate – fuel oil (ANFO). Ammonium nitrite can be acquired in dry, prill form in 20 kg bags. A small batching station would be established in the mine area where each bag of prill is emptied into a container, mixed with 1-1.2 L of fuel oil, and then re-bagged. The bags of ANFO would then be taken underground to the blasting area. The bags would be emptied into a larger container, the ANFO loader. The loader has a pneumatic pump which blows the ANFO into the blast-holes via a flexible hose. Care is taken to avoid 'blow-back' and ANFO spillage. Any spillage is collected. Any residual ANFO in the loader after charging is re-bagged and hauled out to the explosives magazine.

3. *Provide details on how often the sumps located near points of blasting will be tested for ammonia and for how long sampling will continue following the cessation of blasting.*

The sump nearest the blasting face will be tested for ammonia as soon as it is safe to enter the area after blasting. Depending on how far the sump is from the face and the velocity of flow, sampling will be repeated in order to test the early arrival of drainage immediately after the blast. Thereafter, sampling will occur approximately every 30 minutes and continue until confidence is gained that the drainage does not contain ammonia.

4. *Provide the locations, sampling frequencies and the parameters to be monitored for at all sampling locations. Board staff suggests that this information be summarized in a table and on a map.*

This information is also given in the Water License (under SNP). The sampling frequency and analytical parameter information will be given in table format, and sampling locations shown on a figure, in the revised MCP.

A revised version of the MCP incorporating the above responses is provided with this letter for your review.

We look forward to your comments.

Yours truly,

CANADIAN ZINC CORPORATION

"David Harpley"

David P. Harpley
Environmental Coordinator

cc. Alan Taylor, Canadian Zinc Corporation

CANADIAN ZINC CORPORATION

Prairie Creek Project

MINE WATER CONTINGENCY PLAN FOR WATER LICENSE MV2001L2-0003

November, 2004

Revised: July 5, 2005

MINE WATER CONTINGENCY PLAN FOR WATER LICENSE MV2001L2-0003

SUMMARY OF PLAN ACTIONS

- During site operations related to Water License MV2001L2-003, mine water from the 870 m level and the 905 m portal is to be treated in the existing final sump on the 870 m level to remove zinc and other metals at all times. Removal will be achieved by raising the water pH to in excess of 9. A portable site pH meter is to be used to verify that the pH goal has been reached before discharge to the Polishing Pond is allowed. pH measurements are to be made at least twice daily, and a sample is to be taken for the determination of zinc concentration at least daily (see Appendices A and B for equipment and method).

  If parameters are outside of the prescribed range, the water is to be recirculated to the up-stream end of the final sump, or to previous sumps, and adjustments are to be made to the treatment system (e.g. adjust dosage of chemical) to bring the parameters into the prescribed range.

- Mine water accumulating in the new underground development is to be periodically collected in sumps to be built near the active working areas. This water will take one of two possible routes to the final sump on the 870 m level: the water will be directed to flow by gravity within the workings to the lower level; or, the water will be pumped up to the 905 m portal sump and then carried via a pipeline out of the portal and on surface down to, and into, the 870 m portal.

- The absence of ammonia in mine water after blasting underground is to be verified by using ammonia detection strips on water collecting in the sump nearest the blasting immediately after a blast, and for a period thereafter. If a positive detection is made, the water is to be collected and pumped to the Mill for storage and treatment. Consult the text in this document for the treatment approach.

- Process water from the Pilot Plant will be released from the Mill to the Polishing Pond directly, and must have a water quality such that no treatment, other than polishing, is necessary.

- Daily pH and zinc measurements are to be made on Polishing Pond outflow to ensure it is within the range prescribed in the Water License. If parameters are outside of the prescribed range, the water is to be recirculated to the up-stream end of the Pond, or to the sumps underground. In addition, as a back-up, the gate weir on the Catchment Pond is to be raised to prevent discharge to Harrison Creek. Further investigation must be made and actions taken to bring the parameters into the prescribed range.

- The water level in the Polishing Pond is to be monitored at least daily to ensure maintenance of freeboard. If the Polishing Pond is approaching capacity, inflows are to be reduced by the following sequential actions until the capacity of the Polishing Pond has returned to normal:

  - recirculating drill water
  - curtailing flow from the 905 m portal sump
  - curtailing process water discharge from the Pilot Plant; and,
  - recirculating 870 m drainage to up-gradient sumps
  - pumping excess water from the Polishing Pond to the Mill for storage.

  In the very unlikely event that the above water storage sources are not available, as a back-up, the gate weir on the Catchment Pond is to be raised to prevent discharge to Harrison Creek, and excess water is to be temporarily stored in the Catchment Pond. The water is to be managed appropriately later.

Preamble

This *Mine Water Contingency Plan* applies to the new Decline and Pilot Plant projects and operations of Canadian Zinc Corporation at the Prairie Creek Property associated with Water License MV2001L2-0003.

The following formal distribution has been made of this plan:

Mackenzie Valley Land and Water Board

Canadian Zinc Corporation - Prairie Creek Site Office

Canadian Zinc Corporation - Vancouver Office

Additional copies and updates of this Plan may be obtained by writing to:

Canadian Zinc Corporation
Suite 1202-700 West Pender Street,
Vancouver, British Columbia
V6C 1G8
Phone: 604-688-2001
Fax: 604-688-2043
Email: alan@canadianzinc.com

Prairie Creek Minesite Address:

Canadian Zinc Corporation
Prairie Creek Minesite
C/O Villers Air Service,
P.O. Box 328,
Fort Nelson,
British Columbia
V0C 1R0
Satellite phone: 1-600-700-2454
Satellite fax: 1-600-700-9209

TABLE OF CONTENTS

TABLES

FIGURES

APPENDICES

MINE WATER CONTINGENCY PLAN

1.0 INTRODUCTION

1.1 PROJECT OVERVIEW

As part of the ongoing process of establishing, confirming and enhancing the known mineral resource at the Prairie Creek property, Canadian Zinc (CZN) is planning a decline and underground development, including a new portal at elevation 905 m, to permit access for underground exploration, including drilling of the stratabound deposit underlying the Zone 3 quartz vein mineralization. Further delineation of the vein-type mineralization will be undertaken at the same time.

The new 905 m portal will be located approximately 600 m north of the existing Mill, and will provide access to the underground. This will be the fourth portal established on the property to access the underground workings, the others being in the same general area at the 870 m, 930 m and 970 m elevations.

The decline itself will be approximately 3 m in width, 2.3 m high and 600 m long at a maximum 15% downward grade.

CZN also plans to operate a Pilot Plant in the existing Mill over a period of approximately 6 months using a bulk ore sample from underground.

A consequence of these activities is that there is expected to be up to three streams of wastewater for management during site operations, consisting of water from the existing 870 m level, water from the new 905 m portal, and effluent from the Pilot Plant when it is in operation. In compliance with Water License MV2001L2-0003, CZN will direct these streams to a new Polishing Pond to be constructed adjacent to the Mill. Thereafter, the water will be discharged to the existing Catchment Pond, and from there to Harrison Creek.

This Mine Water Contingency Plan explains how CZN plans to manage mine water while operating under Water License MV2001L2-0003, and what contingencies will be available or implemented to ensure the discharge from the Polishing Pond complies with the effluent quality requirements in the License.

1.2 PROJECT SETTING

The Prairie Creek Mine Project is located in the southern Mackenzie Mountains in the south-west corner of the Northwest Territories at 61° 33' north latitude and 124° 48' west longitude (Figure 1). The existing mine infrastructure is situated adjacent to Prairie Creek about 48 km upstream from its confluence with the South Nahanni River, and 32 km upstream of the point where Prairie Creek crosses the boundary of the Nahanni National Park Reserve.

The mine site is at an elevation of 850 m above sea level, and is situated in topography characterized by low mountains and narrow valleys with an average relief of 300 m. Short summers are typical of the area's sub-arctic climate, where the mean annual temperature is -5°C. Annual precipitation is approximately 40 cm, most of which falls as rain.

1.3 MINE WATER DRAINAGE HISTORY

Since its initial development in 1979, water has been flowing out of the existing adit at the 870 m level. The drainage flows into the Catchment Pond, along with other drainage from the plant site, prior to discharge into the receiving environment in the adjacent Harrison Creek (Figure 2).

Since CZN's involvement with the property in 1991, the discharge from the Catchment Pond to Harrison Creek has never exceeded the MMLER maximum grab sample limit for any element, and only exceeded an expired Water License maximum grab sample limit on a single occasion, that being for zinc (0.85 mg/L) on October 18, 1994.

Table 1 compares water quality data for the 870 m portal and the Catchment Pond to the effluent quality requirements listed in the new Water License for discharge from the proposed Polishing Pond. The data shown consists of water samples taken during the tenure of San Andreas/Canadian Zinc i.e. 1991 onwards. The table shows that cadmium and zinc concentrations in mine water have consistently been higher than the requirements in the new License. However, comparison of Catchment Pond water quality to License requirements is more relevant since the Polishing Pond will be the new receptor of mine water discharge. Zinc concentrations in Catchment Pond water have consistently exceeded the maximum average requirement in the new License (0.3 mg/L), but only exceeded the maximum grab requirement once (0.6 mg/L). Cadmium concentrations have always been less than both License requirements.

2.0 GENERAL MINE WATER MANAGEMENT PLAN

2.1 WATER SOURCES AND HANDLING

2.1.1 870 m Portal

This portal allows the gravity drainage of mine water from the lowest elevations and oldest parts of the underground workings, and includes drifts with exposures of vein mineralization. The water is slightly alkaline, and dissolved metals have been recorded, especially zinc.

Various estimates have been made of the volume of this discharge. In a report by DIAND dated July 2002 (Historical Water Quality of the Prairie Creek Project Area), a summary of flow estimates over the period 1981-2001 is presented (Table 2) that range from 0.4 to 16.7 L/sec (23 to 1,000 L/min). However, this range is strongly skewed by two estimates made in 1983, of 8.3 and 16.7 L/sec (500 and 1,000 L/min). The estimates may be anomalous. The next highest estimate is 5 L/sec (300 L/min). In 2001, CZN recorded flows of 1 and 1.3 L/sec (60 and 80 L/min). On June 22, 2004, a flow of 3 L/sec (180 L/min) was measured. Based on these readings, CZN selected 6 L/sec (360 L/min or 0.006 m^3/sec) as the design flow for water management planning, this being towards the high end of the range of measurements, but not at the extreme high end.

A primary collection sump exists approximately 270 m in from the portal of the 870 m adit at an elevation a few metres above 870 m. The sump is 40 m long, 3 m wide and 2.5 m deep, for a volume of 300 m^3. Water collects here by gravity flow.

CZN will construct a new sump closer to the mineralized vein to permit the intermediate collection of vein drainage, and to provide an up-gradient sump for recirculating mine water for temporary storage in the event over capacity problems at the primary sump or Polishing Pond. This sump will be smaller than the primary sump and will have an approximate capacity of 23 m^3.

2.1.2 New Decline

The new decline will be driven primarily in competent carbonate rocks, and will have a more limited intersection with the water-bearing vein compared to the existing workings. As a result, less water is likely to be produced in the new development. Nevertheless, to be conservative, CZN has assumed that mine water produced from the new development will be similar in quantity and quality to water flowing from the existing 870 m level.

CZN has drilled some 40 holes in close vicinity to the proposed line of the decline. All of these holes in the vicinity of the proposed underground decline were into un-mineralized, fairly massive carbonate rocks with no obvious water inflows. None of these holes intersected cavities or significant amounts of ground water. The layout of the decline is designed to take into account the rock through which it is being driven, with the aim being to ensure the majority of tunnelling is in competent rock with minimal water inflows and minimal support requirements. The same rock units that will be penetrated by the decline are exposed in the existing underground workings, and have been observed to be very competent lithologies.

From the new 905 m portal, the access will be driven uphill (+5% gradient) for the first few meters to prevent surface water inflow. Thereafter, once competent rock has been reached in from the surface disturbance, a decline will be driven down hill at a maximum gradient of 15%. A sump will be constructed near the 905 m portal in the sidewall of the tunnel. This will be the primary settling sump for the new development, and will be completely enclosed underground. Sump design will include provision for capture of any floating hydrocarbons.

The mining plan for the new development provides for multiple sumps, each approximately 23 m^3 in capacity, to be constructed along its approximate 600 m length. Water from the face (principally drilling and service water) will flow by gravity to the first and lowest sump. A mid-level sump and top sump are also planned. The sumps will be approximately 200 m in linear distance apart. The sumps will be blasted out of the bedrock in the floor of the decline with ditching directing drainage into them. Water will be conveyed from one sump to the next. Based on a flow rate of 0.006 m^3/s, the retention time of the sumps will be approximately 1 hour.

The primary settling sump will be approximately 3 m wide by 20 m long by 2 m deep for a capacity of 120 m^3. Based on a 0.006 m^3/s flow, the sump will have a retention time of approximately 5.5 hours. This sump will be used primarily to settle out the coarse and midsize fractions of the sediment load in the mine water. The settling sump will be designed such that any overflow from the sump will be directed back down into the decline. Provision will be incorporated into the design of the sump to allow for cleanout of deposited sediment and capture of any floating hydrocarbons. The former will be achieved by a ramp into the back end of the sump to provide access for mine equipment. When clean out is required, sediment will be pumped out by a sludge pump into a tank for transport to a location further into the underground workings on the 930 m level. Sediment will be disposed of underground, or otherwise in an approved manner.

2.1.3 Pilot Plant

The planned Pilot Plant will process ore at a rate of approximately 1.5 tonnes/hour over a single period of approximately 6 months. Process water requirements for the Pilot Plant will be about 2 m^3/tonne of ore. Therefore, the Pilot Plant will use about 3 m^3 of water per hour or 72 m^3/day, half of which will be fresh and half reclaim. As a result, the potential process water effluent discharge will be 36 m^3/day, or 0.0004 m^3/sec, for the limited 6-month period. The effluent is expected to meet the requirements of the License as it will have been subjected to lime treatment in the later stages of the process.

CZN's plan was to mine 1,000-2,000 tonnes of vein material for processing in the Pilot Plant. If 2,000 tonnes are processed, approximately 800-900 tonnes of tailings would be generated. The specific gravity of the tails will be in the range 1.6-1.8 tonnes/m^3. Assuming 850 tonnes at 1.7 tonnes/m^3 equates to 500 m^3 of tails. Therefore, CZN's plan would result in the filling of at least one of the thickener tanks with tailings, may be both, unless tailings are removed during the operating period to a final disposal location based on an approved final tailings disposal plan. It would be feasible to store all of the tailings in the thickener tanks for later remobilisation and disposal.

2.2 MINE WATER MANAGEMENT PLAN

2.2.1 Mine Water

The following mine water management plan will be in effect at all times during the planned site operations. Mine water produced in the underground exploration will be handled through the use of collection sumps, as at present on the 870 m level. The sumps will provide storage and the opportunity to settle suspended matter. Water from the new development that has collected in sumps near the active workings will either be directed to flow by gravity to lower levels, or pumped up to the excavated sump near the 905 m portal. From there, the water will discharge to a pipeline that will carry the water on surface down gradient to, and into the 870 m portal. The water will arrive at the final sump on the 870 m level irrespective of which of the two possible routes it takes. The pipeline from the 905 m portal will be empty when not in use to avoid potential freezing and rupture. The quality of the mine water from the new 905 m sump (SNP Station No. 3-2 in Water License MV2001L2-0003), as well as the mine water on the 870 m level at the point of entry to the final sump (SNP Station No. 3-7), will be monitored at least monthly as required. More frequent sampling will be conducted initially until conditions have stabilized. CZN plans to treat mine water in the final sump on the 870 m level, hence the need to monitor water quality on the influent to the sump.

Following settling and treatment in the primary settling sumps, mine water from the existing 870 m level sump will be discharged to a new Polishing Pond that will be built near the Mill. Figure 3 schematically illustrates the expected water balance during the above noted exploration projects. An estimated maximum mine water flow of 0.012 m^3/sec (and 0.0004 m^3/sec of Pilot Plant effluent during its 6-month operating period) will inflow to the Polishing Pond.

V-notch weirs or other suitable flow measuring devices will be installed on each of the 905 m portal, 870 m level, Polishing Pond and Catchment Pond discharge points. Flows will be recorded in conjunction with development and operations at least weekly during periods of discharge.

2.2.2 Polishing Pond

Construction of a new Polishing Pond is a condition of the Water License. The primary purpose of the new Polishing Pond is to provide polishing for inflowing mine water, and treated process water discharged from the Pilot Plant. The Pond will provide additional retention time for the settlement of finer particles. Water treatment with the addition of chemicals could be conducted in the Polishing Pond. However, CZN prefers to do this underground (and in the Mill) where the environments are more controlled and are not exposed to the elements. This approach also maintains the true purpose of the pond for polishing. Water from the final 870 m level sump would be pulled from below the surface of the sump by use of a weir or stilling well, and then conveyed to the Polishing Pond in the Mill Yard. There, the settling of suspended solids will occur, followed by discharge to the main Catchment Pond, prior to final disposal to Harrison Creek via the primary discharge point.

The Polishing Pond will be sized based on flow volumes reporting to it to allow sufficient retention time to effect settling. Typical criteria for such sizing suggest a pond with a retention time of 20 hours is required. The preliminary design for the Polishing Pond is for a pond 55 m long, and between 41 and 57 m wide (see Figure 4). The non-rectangular shape is to make best use of the proposed pond site adjacent to the Mill. Internal baffles or berms will be employed to prevent short-circuiting and maximize retention times and settling. Provision will also be included for the use of settling aids, such as flocculants, if necessary to facilitate settling of solids.

Water discharged from the new Polishing Pond (SNP Station No. 3-4), will be monitored in accordance with the Water License (weekly during operations, twice in the summer after operations cease) and must comply with the effluent quality requirements specified in Part D, Section 5 prior to discharge to the existing Catchment Pond. The discharge from the Catchment Pond (SNP Station No. 3-5) into Harrison Creek (SNP Station No. 3-6) and subsequently Prairie Creek downstream of the confluence with Harrison Creek (SNP Station No. 3-11), will also be monitored as per the Water License. The water level in the Polishing Pond will be monitored at least daily to ensure maintenance of freeboard.

2.2.3 Potential Contaminants and Water Treatment

CZN recognizes that there are potentially two main types of contaminants that could exist in the water inflowing to the Polishing Pond, metals and ammonia.

Zinc

As discussed above, the principal metal of concern is zinc. CZN is confident that, if the concentration of zinc is controlled, the concentrations of other metals will be controlled, including cadmium. CZN intends to manage and treat mine water (and Pilot Plant process water) at the source before discharge to the Pond. When operations are in progress on-site, CZN plans to treat underground water in the final 870 m level sump to remove zinc and other metals. CZN will set-up an automatic dosing system for the addition of a treatment reagent. This will either be lime or soda ash, both of which are already available on-site. The intent will be to raise the pH of the mine water from the natural 7.7-8.2 range to a pH in excess of 9 to precipitate zinc. Based on well established geochemical behaviour, CZN expects other metals in solution will co-precipitate. A more detailed description of the treatment plan is given in Section 2.2.4 below.

Ammonia

Underground development will involve the use of ANFO (ammonium nitrate-fuel oil) as the explosive of choice. Ammonium nitrite can be acquired in dry, prill form in 20 kg bags. A small batching station would be established in the mine area where each bag of prill is emptied into a container, mixed with 1-1.2 L of fuel oil, and then re-bagged. The bags of ANFO would then be taken underground to the blasting area. The bags would be emptied into a larger container, the ANFO loader. The loader has a pneumatic pump which blows the ANFO into the blast-holes via a flexible hose. Care is taken to avoid 'blow-back' and ANFO spillage. Any spillage is collected.

Any residual ANFO in the loader after charging is re-bagged and hauled out to the explosives magazine.

There is a potential for ANFO spillage as blast holes are charged, and for misfires during blasting, although great care will be taken to avoid this. ANFO is soluble, potentially leading to elevated ammonia concentrations in mine water. CZN will seek to avoid this by the following actions:

- Minimizing explosive use by reducing powder factors to the minimum required to achieve effective blasting; and,
- Ensuring proper handling and housekeeping with respect to explosive use underground (to minimize and clean-up spills).

CZN will maintain a sump relatively close to the site of blasting. The sump will be equipped with a pump and line to carry water to the Mill. Immediately after blasting, and for a period thereafter, CZN will monitor sump water for elevated ammonia levels. The sump nearest the blasting face will be tested for ammonia as soon as it is safe to enter the area after blasting. Depending on how far the sump is from the face and the velocity of flow, sampling will be repeated in order to test the early arrival of drainage immediately after the blast. Thereafter, sampling will occur approximately every 30 minutes and continue until confidence is gained that the drainage does not contain ammonia.

Ammonia strips, which are similar to pH strips, will be used for ammonia monitoring. The ammonia strips that will be used detect in the range 0.2-10 mg/L. CZN intends to use these for ammonia detection, not for the precise estimation of ammonia content. Any detection will trigger the contingency approach for managing ammonia in minewater. In addition, CZN will take samples for external laboratory analysis to verify the accuracy of this approach.

If a positive indication of ammonia presence is indicated, sump water will be pumped to the Mill for temporary storage. The quantity of water for storage is likely to be relatively small, and the available tankage in the Mill (see Table 2) will be more than adequate for needs. Storage in the Mill will allow for volatilization of un-ionized ammonia (NH_3), and oxidation and biological nitrification of ammonia to less toxic nitrate. Ammonia can also readily be removed from water with the addition of chlorine. However, there is concern with respect to chlorine addition and the formation of chloramines. Therefore, chlorine will not be used. The water will be kept in the Mill until testing indicates the water can be returned to the mine for metals treatment. When this is done, the pumping rate will be low so that the water is blended with minewater judged to be free of ammonia as a further contingency. The reasons for returning the water underground are two-fold:

- The water may still have an elevated zinc concentration, and therefore it needs to join the mine water drainage flow path upstream of the final sump; and,
- The flow path from upstream of the final sump to the Polishing Pond will provide a further opportunity for the dissipation of any residual ammonia concentrations before the water reaches the Pond.

With this approach, CZN believes the influent to the Polishing Pond will meet the requirements of the License specified for Pond outflow (SNP Station No. 3-4). This built-in redundancy and back-up should ensure that Pond discharge always meets license requirements.

Hydrocarbons

Oil absorbent pads and/or booms will also be employed at each of the sumps and the Polishing Pond. An oil absorbent boom is currently in place across the discharge point of the Catchment Pond. Hydrocarbons will be captured by absorbent booms across the outlet of the sumps and/or weirs across the width of the sumps, forcing clean water to flow under the weir and floating hydrocarbons to be retained on the surface behind the weir much in the same manner as standard oil/water separators. Any oils so retained will be soaked up by absorbent pads. Pads and booms will be inspected regularly and replaced as required. Oily pads and booms will be placed in barrels and disposed of in an approved manner.

If petroleum hydrocarbons are present in the Polishing Pond, they will most likely be in the form of floating fuel, perhaps from a diesel spill or leak. In the unlikely event that the water in the pond itself has dissolved petroleum hydrocarbon concentrations exceeding license limits, CZN will use a portable activated carbon vessel to remove the hydrocarbons from pond discharge prior to the Catchment Pond.

2.2.4 Treatment Plan for Zinc

Approach

Temperature has a significant effect on the calculated pH for any particular concentration of dissolved metal. Higher temperatures require less acid neutralization, and therefore lower pH's to achieve adequate metal stabilization as a precipitate. To achieve a level of 0.30 mg/l of zinc at 25°C, the pH must be raised above 8.5. At 5°C and a slightly more conservative concentration of 0.20 mg/l, the pH would necessarily be set at 9.12. Controlling the pH at 9.1 would achieve the necessary zinc control. CZN is aware that the discharge pH needs to be below 9.5. CZN intends to set the soda ash dosing so that a target pH of less than 9.5 is achieved. CZN is confident that this will be sufficient to satisfactorily remove metals, and render the final discharge from the Polishing Pond less than 9.5 due to alkalinity consumption along the flow path.

The mine water at Prairie Creek is naturally at the high end of the neutral range with a pH typically between 7.7 and 8.2 as a result of the mine water making contact with the carbonate host rock. There are several reagents that can be used to treat the mine drainage water to raise the pH to the desired level of 9.1. Water treatment with calcium hydroxide (lime) is in general usage all over North America for drinking water as well as mine drainage. Lime is particularly useful where there is a significant neutralization requirement for acidic water and particularly where suspended solids are a problem. The calcium in solution enhances the flocculation of fine precipitates and improves the settling characteristics in a manner similar to alum. A minor disadvantage occurs when the lime requirement is high and large quantities of sulphate are present. A coating of calcium sulphate can contribute to scaling and increase the maintenance requirements of the treatment system. The discharge at Prairie Creek does not have significant turbidity due to suspended solids and currently requires only a small pH adjustment. This can be achieved by the use of sodium carbonate (soda ash).

Control Circuit Design

Mine drainage will collect in the primary sump near the 870 m portal. The sump has a capacity of 300 m^3. This is the preferred site to effect pH adjustment and control by the criteria based addition of a saturated sodium carbonate solution. The estimated flow rate of water from the portal is approximately 6 L/sec, currently with a nominal pH of 8.1. The required equipment includes a pH controller with automatic temperature adjustment, some mixing capacity and a small tank for reagent mixing and distribution. A proportional approach pH controller can be used to adjust pH to a set point of 9.1, with timed additions of an estimated 21.6 L/hour of 100 g/L sodium carbonate solution. This implies a consumption of less than 60 kg/day of soda ash. There are approximately 200 tonnes of soda ash on-site. The sodium carbonate addition is subject to modification to accommodate any acidity due to the dissolution of hydrolyzable metals, such as iron, or any changes in the influent pH. A change in influent pH down to 7.1 would require approximately an order of magnitude more neutralizing reagent. The velocity of water through the sump is such that a moderate amount of mixing will be required to avoid excess dosage of pH adjustment reagent. The mixing can be made more efficient by building a weir through which all of the mine water must pass before continuing on to the Polishing Pond. With the treatment occurring at the sump, the Polishing Pond becomes the polishing or equilibration stage.

Monitoring

Monitoring of the dissolved zinc will be done initially at an accelerated schedule to ensure the efficacy of the mine water treatment. CZN has a pH meter on-site, and will use it to ensure the appropriate pH is maintained in the sump for removal of metals from solution. While CZN will comply with SNP monitoring requirements, this will not provide timely results to confirm adequate treatment of mine water and ensure license water quality requirements are met. Consequently, in addition to use of the pH meter, CZN plans to use a portable ultra-violet spectrophotometer that can be used to determine zinc content colourimetrically (see Appendix A for meter description). The meter to be used has a test range of 0.2-3.0 mg/L. Field waters can be readily tested for zinc concentration using the meter, with confirmation against prepared standards (see Appendix B for test method). The meter will be used to confirm water streams requiring treatment, the success of the treatment, and an acceptable range of discharge from the Polishing Pond. Results will be available within a few hours instead of several days, and will allow timely adjustments to water management activities. Representative water samples will also be collected and sent off-site for the analysis of metals (by ICP) to confirm the accuracy of site data and colourimetric standards, and the removal of all problem metals. A correlation between the two will be developed to improve the predictability of zinc concentrations from on-site measurements.

During commissioning of the underground water treatment system, intensive pH and zinc concentration monitoring will be conducted (approximately hourly). Once confidence is gained that the treatment approach is performing as planned, the frequency of monitoring will gradually decrease, but at no time will it be less that two pH measurements a day, and one zinc measurement a day.

CZN will comply with the SNP monitoring requirements as specified in the Water License (under SNP). The sampling frequency and analytical parameter information is summarized in Table 3. Sampling locations are shown in Figure 5.

Sludge

Sludge from treatment will accumulate in the 870 m level final sump, and may need to be periodically removed to ensure on-going treatment is not compromised. The sludge will be removed using a sludge pump. The sludge will be pumped into a portable tank. After pumping, the tank will be taken further underground to a temporary disposal location on the 930 m level that is isolated from drainage. The disposal location is a blind drive with a downhill grade that will provide containment. The sludge will remain geochemically stable in the alkaline underground environment. However, even if leaching occurs, the leachate will report to the final sump and will be subjected to treatment. The sludge could be re-handled later for final disposal.

3.0 CONTINGENCY PLAN – EXCESS WATER

3.1 NORMAL OPERATING CONDITIONS

Under normal operating conditions, if the combined volume of the water sources is about to encroach on the freeboard of the Polishing Pond, a number of contingencies are available to rectify the situation:

- Drill water can be recirculated to lessen the volume of mine water discharge;
- Mine water can be pumped-back to previous sumps;
- The pumps in the decline can be switched off, and the development allowed to temporarily, partially flood; and,
- Process water from the Pilot Plant can be temporarily retained in the Mill tankage, and in the unlikely event tankage storage capacity is not available, operation of the Plant can be stopped.

Water for drilling is usually obtained from the nearest sump to the working face. By design, drainage from the face reports to the sump and then overflows to the adit. Therefore, drill water is recirculated when drilling is in progress.

All of the above contingencies can be implemented without stopping exploration operations underground, including new development and/or exploration drilling. If water is still in excess after implementing these contingencies, these operations can be shut down also, and more complete flooding of the new development allowed.

In the event that water volumes are continuously greater than expected, pumps and water management facilities would be upgraded to handle the increased flows accordingly. CZN will install larger or multiple pumps, and if necessary, expand the capacity of storage sumps and polishing. If additional sump capacity is needed, it will be relatively easy to enlarge existing sumps or create new ones underground by drilling and blasting. The existing treatment sump is quite large, and is unlikely to need enlargement. Higher flows will mean a greater soda ash demand to increase pH, which will be supplied by the ph-controlled, metered dosing system. If additional polishing capacity is required, CZN will build a secondary polishing pond before the Catchment Pond.

If water volumes were found to be significantly greater than expected, and greater than the capacity of the water management facilities in place, work in the new development will be halted and the areas of inflow will be grouted. As a last resort, the development will be allowed to flood until such facilities were upgraded to handle the greater volumes of water, at which time dewatering and underground development could commence once again.

3.2 ABNORMAL OPERATING CONDITIONS

The Prairie Creek site is not typically prone to intense rainstorms. However, a surface water flow peak could arise from sudden warm weather during spring melt, coupled with heavy rainfall. Because the mine workings are underground in rock of relatively low permeability, such an event may have some influence on the volume of mine drainage, but is unlikely to cause a major increase. The range of increases would likely be readily managed by the contingencies described above.

The consequence of a heavy rainstorm might be the flooding of the Polishing Pond, which will be exposed to the elements. In such an event, pond water can be pumped to tankage in the Mill for temporary storage, or to sumps and the new development underground.

Table 2 provides details of the storage capacity available in tankage in the Mill. The tanks are clean, they have never been used. There is no potential for contamination of minewater from tank residues.

The thickener tanks may be in use for operation of the Pilot Plant. To be conservative, we can assume that one of the thickeners is full with a mixture of tailings and process water. We can also assume that one of the surge tanks is in use for the temporary storage of mine water contaminated with ammonia (a 35 m^3 capacity which equates to approximately 1.5 hours of normal development water flow at 6 L/sec). If emergency storage of mine water is required, water can be pumped to the fresh water tank first. The metals in the mine water will not negatively impact the Pilot Plant. The available storage of 135 m^3 is equivalent to 3 hours of combined normal mine drainage at 12 L/sec. If additional storage is required, the other thickener and/or surge tank can be used next. Thereafter, concentrate stock, conditioner and reagent stock tanks are available for a combined capacity of 148 m^3. The stored water will be pumped back underground later for treatment.

In the unlikely event of Polishing Pond discharge to the Catchment Pond before acceptable water quality has been verified, it should be recognized that a sudden peak in inflow to the Polishing Pond will consist of relatively uncontaminated runoff which will tend to 'dilute' the pond water. The Catchment Pond will itself also be receiving higher runoff flows, thus providing further dilution. The Catchment Pond has a capacity of 5,000 m^3, is bounded by large berms, and is equipped with a gate weir to provide controlled discharge to Harrison Creek. The gate weir consists of a shutter that slides vertically in two metal guide rails which are positioned over the end of a horizontal decant pipe. The shutter can be positioned to prevent discharge almost completely (there is minor leakage around the sides of the shutter within the metal guides), or to allow discharge subject to a selected pond water level. Therefore, the pond is available as a temporary storage location for excess water until other water management options are available.

In abnormal circumstances where very high flows are experienced underground, say from a sudden and unexpected in-rush of groundwater from storage, as such flows will almost certainly be correlated with acceptable water quality, this water could be directed to the Catchment Pond directly, omitting the Polishing Pond. CZN is aware that direct discharge to the Catchment Pond bypassing the Polishing Pond raises the issue of compliance. Firstly, this is very unlikely to happen because minewater flows are not strongly influenced by storm events. Also, a sudden in-rush of water underground, if it occurred, would occur during decline development, in which case the in-rush would have to first flood the decline and then spill into the rest of the workings. Secondly, direct discharge to the Catchment Pond would only be allowed if CZN is confident that license criteria can be met (the water would be sampled to confirm this). If CZN is not confident that direct discharge to the Catchment Pond would meet license criteria but has no choice, the gate weir on the Catchment Pond will be closed until confirmation is obtained that the quality of the water is acceptable for discharge. Such in-rushes underground are not common, and when they occur, they are of relatively short duration. CZN will follow standard mining practice and NWT mining regulations, which require preparation of a development plan which will include precautions against water inrushes. This will include drilling of cover holes ahead of development to prevent unexpected water inflow. In order to take a further sample of vein material, the development will be driven into the vein for a distance of only about 5-10 metres.

The Catchment Pond has substantial storage capacity. Even with the water level at the top of the discharge pipe, there would still be a freeboard in excess of 0.5 m. CZN has operated the pond for many years, and pond levels have never approached the crest or any elevation where instability might occur. The dikes are also inspected annually for stability and condition, and no concerns have been noted with respect to the Catchment Pond.

CZN believes that the water volumes from the new development will be mostly restricted to service and drilling water, with minimal amounts of ground water. It is CZN's opinion that zinc and other metal levels in new development water will be minimal because of the very short length of the decline in mineralization, and the lower levels of oxidation in the vein at this depth.

The design of the decline will be such that all water must be pumped up to the final settling sump. In the event that the sump overtops, the water will flow back into the decline, not out of the portal. The total volume of the development when complete will be in excess of 4,100 m^3, which will provide storage for at least 190 hours in the event of a pump failure. All water produced by the Pilot Plant will be contained in the Mill tankage until such time as it is suitable for discharge. Work on the Pilot Plant would be halted in the event that tankage becomes full, and resumed once the water has been treated to a level which will allow discharge within License provisions.

4.0 CONTINGENCY PLAN – WATER QUALITY

The mine water management plan described above has a number of built-in contingencies and back-ups to ensure that the discharge from the Polishing Pond always meets License requirements. These contingencies can be described as follows:

- The first contingency is treating the mine water in a sump underground, leaving the Polishing Pond for settling and chemical stabilization (polishing);

- The next contingency is monitoring. Mine water is monitored as it flows into the treatment sump, and treated mine water (and Pilot Plant process water (is monitored prior to discharge to the Polishing Pond. Monitoring will consist of pH measurements and zinc concentration estimation using colourimetry. If the target pH level is not met with treatment, or zinc concentrations remain elevated, mine water will be recirculated to up-gradient sumps, and process water will not be pumped from the Mill, respectively;

- The contingency and back-up for failure of the step above is the Polishing Pond itself. Even if the treated water inflowing to the Pond still has an elevated zinc concentration, there will be some reaction, attenuation and dilution in the Pond before discharge;

- If for some reason there is an unexplained metals spike in Polishing Pond discharge, the water can be pumped back to either the up-stream end of the Pond, an intermediate or final sump underground, or in the absence of available storage, the Mill. Inflows to the Pond could also be curtailed, thus enabling discharge to cease. This would be achieved by recirculating mine water underground, and if the Pilot Plant is operating, retaining process water in the Mill. If this is not possible, the Plant can be stopped. As a last resort and back-up in an emergency, the water can be allowed to flow into the Catchment Pond and temporarily contained there for later recovery. The water is still prevented from discharging to Harrison Creek; and,

- If ammonia is liberated into solution underground despite the best efforts of site staff, it will first be detected by monitoring in the nearest sump to the blasting immediately after liberation, and the affected water will be collected in the same sump and/or an intermediate sump and pumped to the Mill for temporary storage in one of the tanks. There, the water will be stored and/or treated until the ammonia has been removed. If the ammonia-contaminated water escapes immediate detection and collection, it can still be caught down-stream in the subsequent sump before discharge to the Polishing Pond.

Despite CZN's best monitoring efforts, it is possible that minewater with elevated metal concentrations may discharge from the treatment sump to the Polishing Pond. If this occurs, CZN will have four options:

- pump treatment sump discharge to an up-gradient sump, thus stopping inflow to and outflow from the Polishing Pond;
- pump Polishing Pond outflow to mine sumps;
- pump either treatment sump or Polishing Pond outflow to the Mill; and,
- add soda ash to the Polishing Pond to raise pH.

Some of these options could be used in combination. If there was a problem with dosing in the treatment sump such that pH was not kept elevated, there may be a marginal increase in metals concentrations in the Polishing Pond. Soda ash addition to the pond would rectify this, perhaps in combination with recirculation of treatment sump outflow to allow greater residence time in the pond.

One of the reasons CZN decided to treat minewater underground was to preserve the Polishing Pond for settling only, during normal operating conditions. This is expected to polish the water such that suspended matter and total metals will be at a minimum in the discharge. Flocculants will be used as a contingency if the desired settling is not achieved because particles are too small.

5.0 SUMMARY

Implementation of this Mine Water Contingency Plan during site operations will ensure that there is minimal risk of contaminating receiving waters for the following main reasons:

- CZN has committed to monitoring pH, zinc and ammonia levels on-site, and taking appropriate management actions;

- CZN has committed to operating a treatment plant underground for the removal of metals (primarily zinc) from mine water, and will be prepared to treat the water to remove ammonia, if necessary;

- A new Polishing Pond will be built and the outflow must comply with Water License requirements;

- The Polishing Pond will discharge into the Catchment Pond which will still provide temporary storage for all site drainage, and further attenuation of any contaminants before discharge to Harrison Creek;

- Excess water can be managed internally by recirculating drill water, recycling drainage to the sumps underground, stopping the pumps in the new development, using the considerable available storage in the tankage in the Mill, and in a dire situation, the new decline itself could be used for substantial emergency storage; and,

- CZN will ensure discharge from the Polishing Pond meets Water License requirements by monitoring inflows and outflows, and recirculating water to the upstream end of the Pond, the treatment sump, other sumps or if necessary, the Mill, if it appears Pond outflow will not comply.

TABLE 1: PRAIRIE CREEK MINE AND POND WATER QUALITY

Description	pH (Units)	EC (uS/cm)	TSS mg/L	Arsenic mg/L	Cadmium mg/L	Chromium mg/L	Copper mg/L	Mercury mg/L	Nickel mg/L	Lead mg/L	Zinc mg/L	Ammonia (as N) mg/L
Water License Max Grab	6-9.5		30	1	0.01	0.3	0.2	0.04	0.4	0.3	0.6	10
Water License Max Average	6-9.5		15	0.5	0.005	0.15	0.1	0.02	0.2	0.15	0.3	5
SNP 3-7, 870 portal drainage												
06/30/92	7.5	950	<3	0.0008	0.075	0.010	0.098		0.017	0.027	15.2	
09/15/93	7.7	936	<3	<0.0003	0.0169	0.0001	0.047		0.017	0.0253	9.1	
07/31/94				<0.2	0.043	<0.015	0.012		<0.2	<0.05	1.9	
07/31/94				<0.2	0.041	<0.015	<0.01		<0.2	<0.05	1.2	
06/23/94	8.0	943			0.041	0.0034	0.021		0.02	0.014	7.2	
07/31/94	7.7	1100	5	0.003	0.084	0.00025	0.062	0.00004	0.02	0.040	15.8	
10/18/94	8.0	963		0.002	0.038	0.0031	0.033		0.01	0.020	8.0	
06/15/95	7.7	1010		0.0011	0.0416	<0.0002	0.0230		0.0169	0.0213	8.4	
08/03/95	7.8	1030	<3	0.0028			0.0846		0.0173	0.0397	16.0	
09/28/95	7.9	1020		0.0021	0.0679	0.0032	0.0489		0.0162	0.0272	12.4	
08/18/99	7.9	1110	12	0.0013	0.0638	<0.003	0.0345	<0.00001	0.0147	0.0254	9.8	
08/30/01	8.2	1090	<3	0.0006	0.0384	<0.001	0.0133	<0.00005	0.0100	0.0140	7.1	<0.005
06/28/02	8.1	1070	<3	0.0004	0.0446	<0.001	0.0121	<0.00005	0.0120	0.0107	5.7	0.027
SNP 3-5, Catchment pond discharge												
07/13/93	8.74	352	<3	<0.0003	0.0006	0.001	0.127		0.001	0.0036	0.120	
09/15/93	7.86	739	<3	<0.0003	0.0006	0.001	0.002		0.004	0.0112	0.520	
06/23/94	7.93	707			0.0006	0.0012			0.005	0.0088	0.504	
07/31/94				0.003	0.0005	0.00025	0.0025	0.00004	0.003	0.013	0.443	
10/18/94	7.85	854		<0.0003	0.0001	0.0041	0.0007		0.006	0.006	0.851	
06/15/95	7.92	788		0.0005	0.0007	0.006	0.0001		0.0046	0.0102	0.538	
08/03/95	8.05	672	<3	0.0008	0.0009	0.0019	0.0023		0.0038	0.0115	0.492	
09/28/95	7.92	738		0.0004	0.0007	0.0027	0.0016		0.0044	0.0079	0.547	
08/30/01	8.30	736	4	0.0008	0.00171	<0.0005	0.0073	0.00018	0.004	0.018	0.591	
06/28/02	8.22	663	<3	0.0006	0.00072	<0.0005	0.0020	<0.00005	0.002	0.008	0.483	<0.005

EC = Electrical Conductivity
TSS = Total Suspended Solids
Exceedences indicated thus

TABLE 2
AVAILABLE STORAGE CAPACITY OF PRAIRIE CREEK MILL TANKAGE

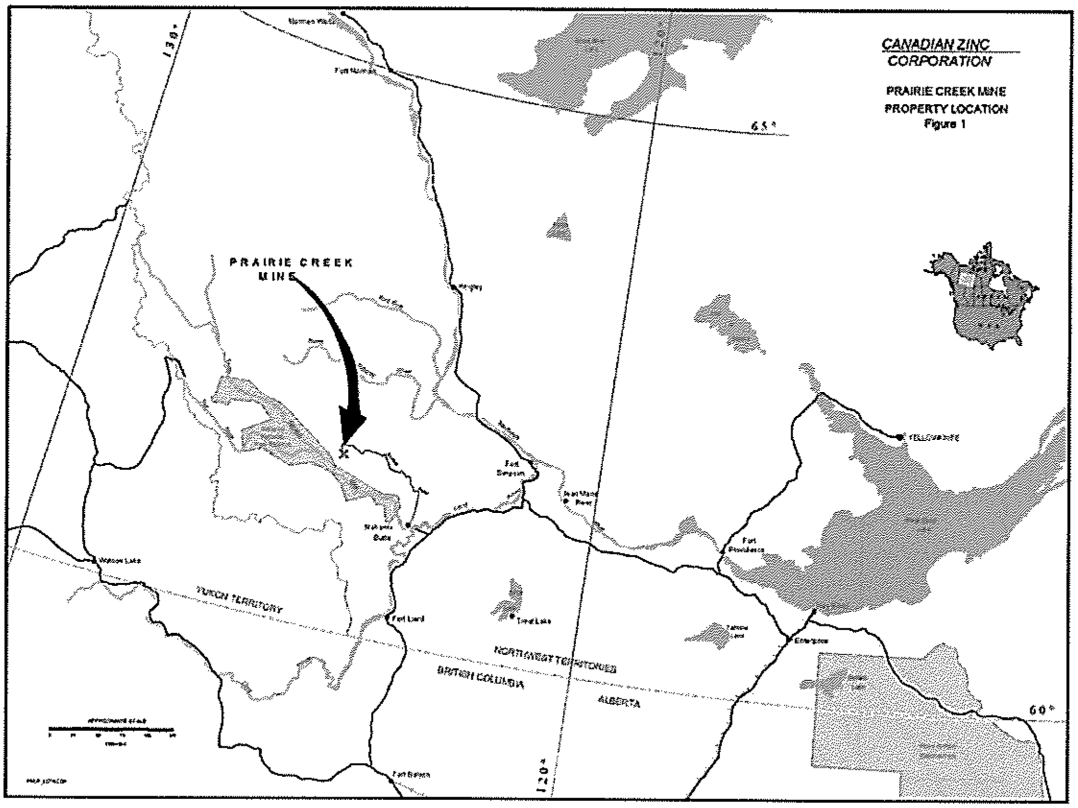
No.	Tank Description	Tank Dimensions D x H (ft)	Tank Dimensions D x H (m)	Tank Storage Capacity (m^3)
1	Thickener No. 1	35 x 10	10.7 x 3.1	270
2	Thickener No.2	35 x 10	10.7 x 3.1	270
3	Surge Tank No. 1	12 x 11.5	3.7 x 3.5	35
4	Surge Tank No. 2	12 x 11.5	3.7 x 3.5	35
5	Concentrate Stock Tank	10 x 18	3.1 x 5.5	40
6	Conditioner No. 1	8 x 9	2.4 x 2.7	12
7	Conditioner No. 2	7 x 7	2.1 x 2.1	7.5
8	Conditioner No. 3	6 x 6	1.8 x 1.8	5.0
9	Conditioner No. 4	4 x 4	1.2 x 1.2	1.5
10	Reagent Stock Tank No. 1	8 x 8	2.4 x 2.4	11
11	Reagent Stock Tank No. 2	8 x 8	2.4 x 2.4	11
12	Reagent Stock Tank No. 3	6 x 6	1.8 x 1.8	5.0
13	Reagent Stock Tank No. 4	6 x 6	1.8 x 1.8	5.0
14	Reagent Stock Tank No. 5	6 x 6	1.8 x 1.8	5.0
15	Reagent Stock Tank No. 6	6 x 6	1.8 x 1.8	5.0
16	Reagent Stock Tank No. 7	6 x 6	1.8 x 1.8	5.0
17	Reagent Mix Tank No. 1	4 x 4	1.2 x 1.2	1.5
18	Reagent Mix Tank No. 2	4 x 4	1.2 x 1.2	1.5
19	Reagent Mix Tank No. 3	4 x 4	1.2 x 1.2	1.5
20	Reagent Mix Tank No. 4	4 x 4	1.2 x 1.2	1.5
21	Reagent Mix Tank No. 5	4 x 4	1.2 x 1.2	1.5
22	Reagent Mix Tank No. 6	4 x 4	1.2 x 1.2	1.5
	Total			**732**

TABLE 3
SNP SAMPLING FREQUENCIES AND ANALYTICAL PARAMETERS

Station	Location	Frequency			
		Weekly	Monthly	x2 annual	6 mo
3-1	Well House				X
3-2	905 portal drainage	X			
3-3	Pilot plant discharge	X			
3-4	Polishing pond discharge	X			
3-5	Catchment pond discharge	X			
3-6	Harrison Creek at Prairie	X			
3-7	870 portal drainage	X			
3-8	Reagent catchment basin			X	
3-9	Harrison Creek upstream		X		
3-10	Prairie Creek upstream		X		
3-11	Prairie Creek downstream		X		

Station	Suspended Solids, pH, Conductivity	Total Alkalinity, Total Hardness	ICP Metals & Total Hg	Ammonia	Cyanide	TPH	BOD and Coliforms
3-1	X	X	X				X
3-2	X		X	X			
3-3	X		X	X			
3-4	X		X	X			
3-5	X		X	X		X	
3-6	X		X	X		X	
3-7	X		X	X			
3-8	X		X	X	X		
3-9	X		X	X			
3-10	X		X	X			
3-11	X		X	X	X		

Note: Record weather, field temperature and pH at all sites


CANADIAN ZINC
CORPORATION
PRAIRIE CREEK MINE
PROPERTY LOCATION
Figure 1
PRAIRIE CREEK
MINE
YUKON TERRITORY
NORTHWEST TERRITORIES
BRITISH COLUMBIA
ALBERTA
YELLOWKNIFE
130°
120°
65°
60°

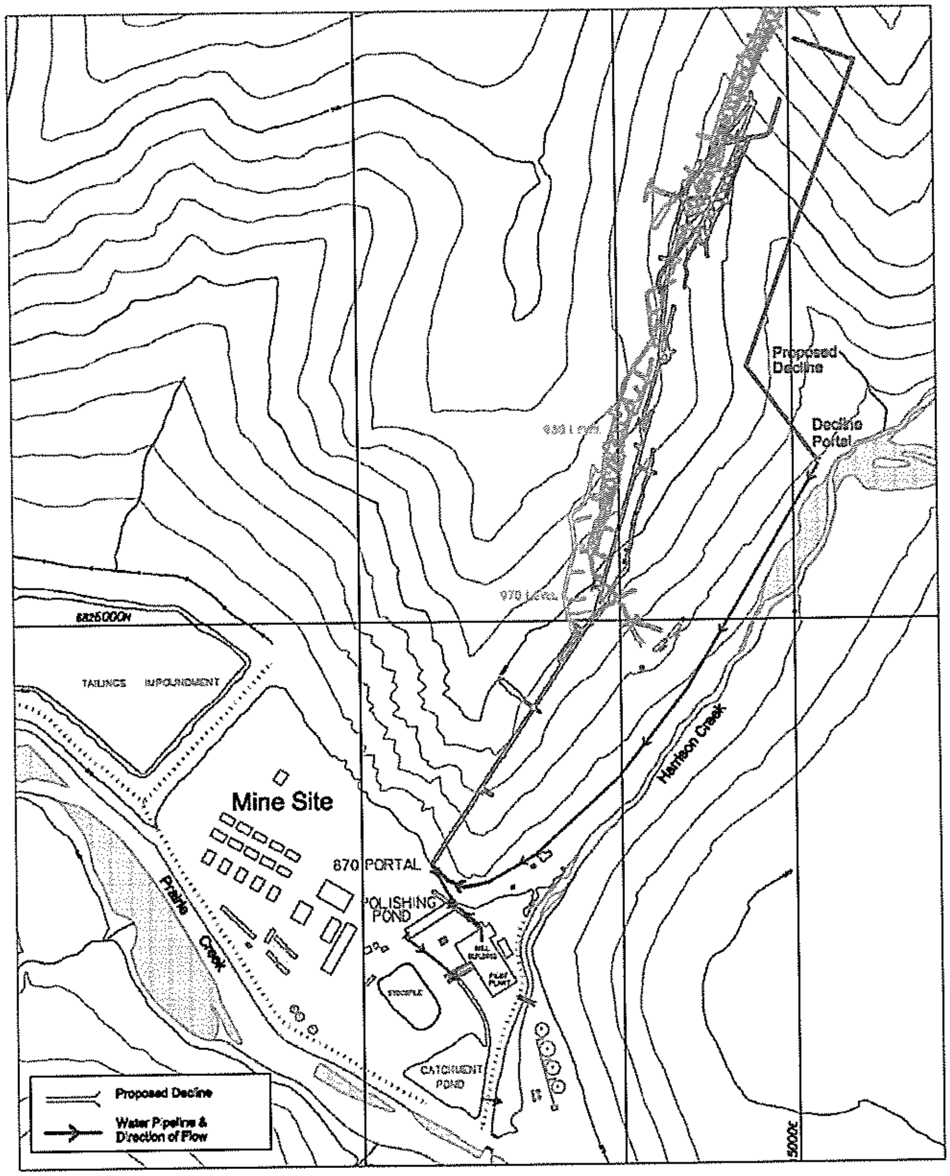


Figure 2: Prairie Creek Mine Water Management Site Plan

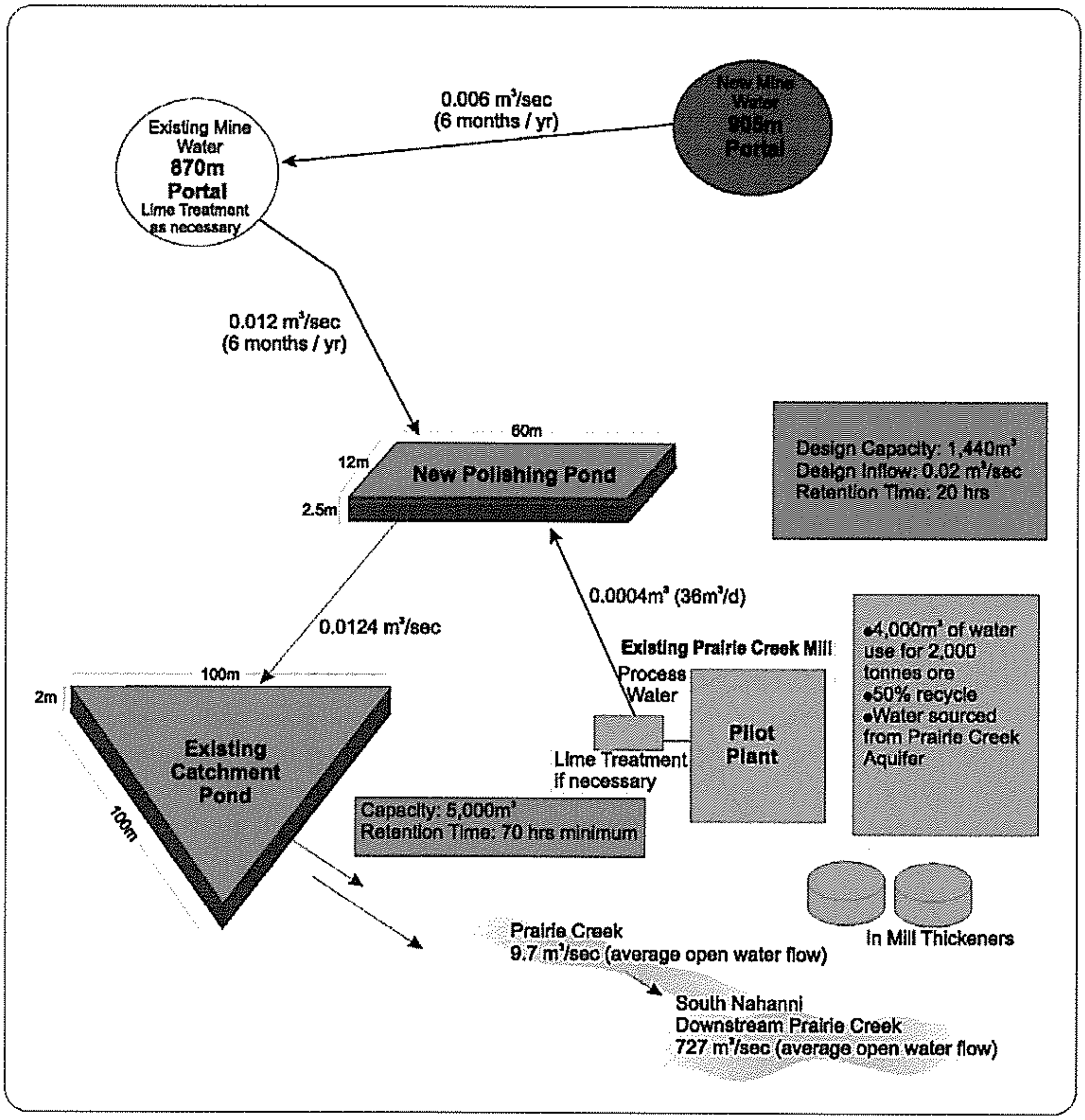
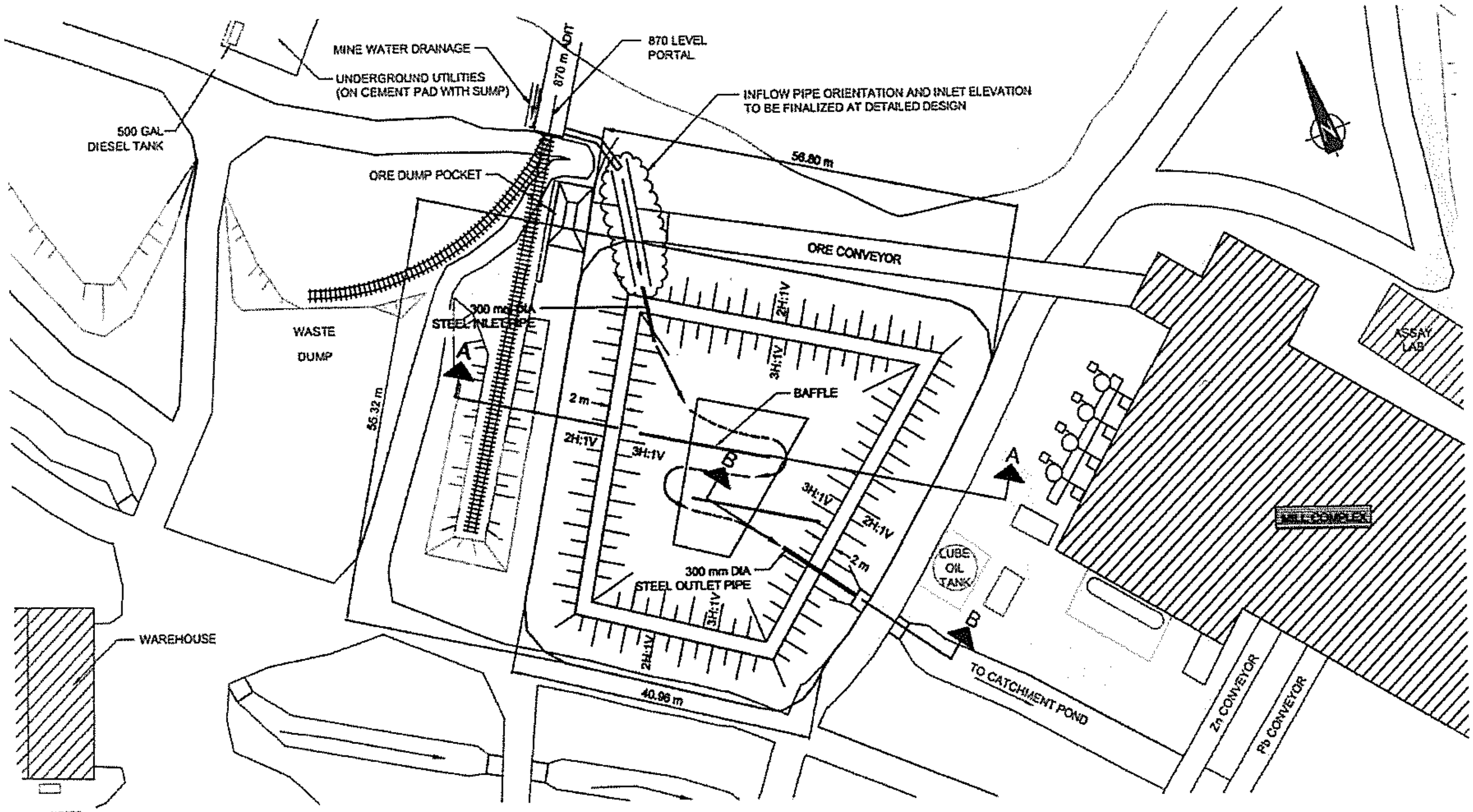


Figure 3: Prairie Creek Decline and Pilot Plant Water Balance



NOTES:

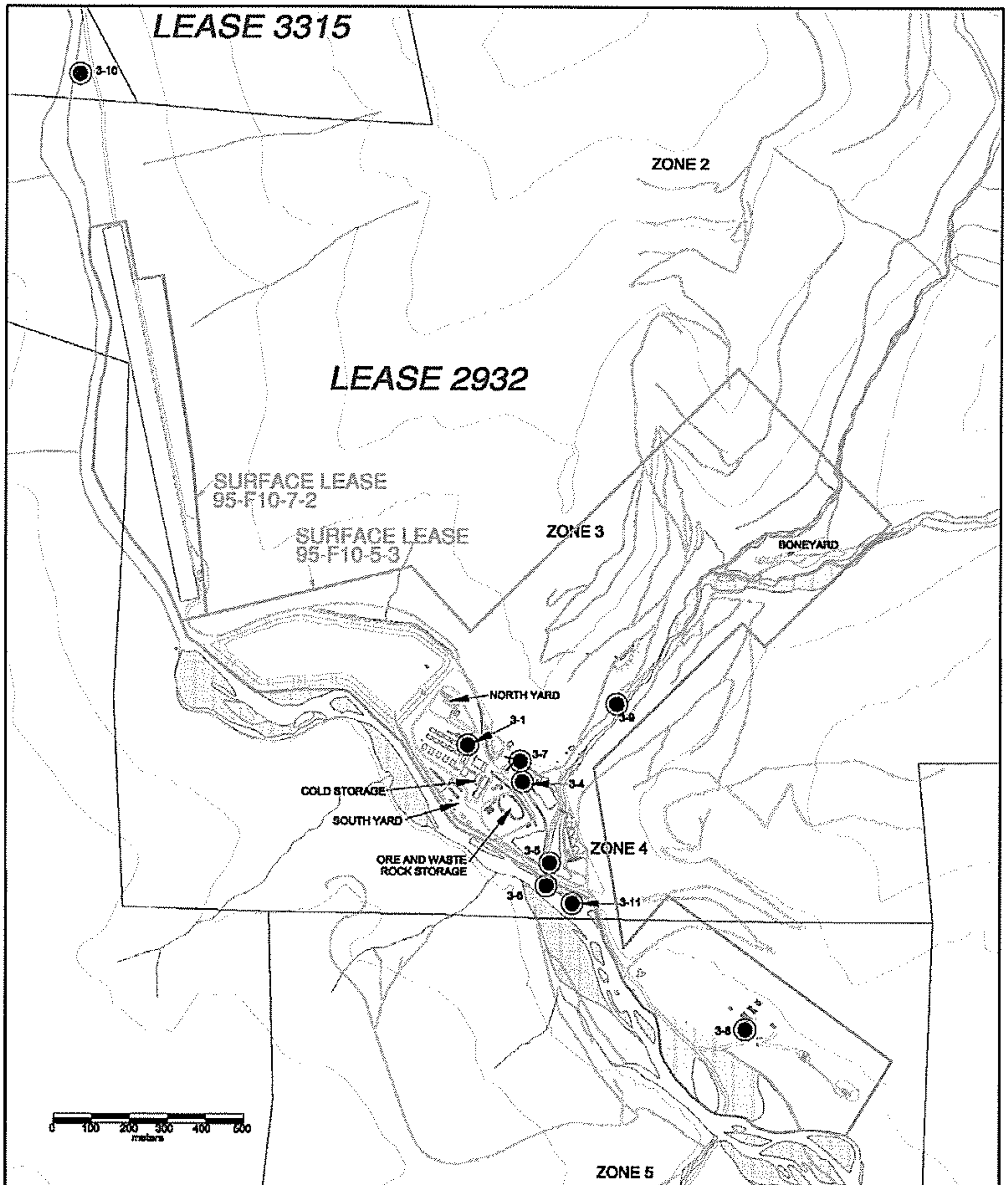
1. BASE PLAN PROVIDED BY CANADIAN ZINC CORPORATION. INFRASTUCTURE ELEVATIONS NOT INCLUDED ON BASE PLAN.
2. TOPOGRAPHIC SURVEY NOT COMPLETED AT DESIGN SITE. ORIGINAL GROUND TOPOGRAPHY ASSUMED.

0 25
metres

Figure 4

Pond Layout

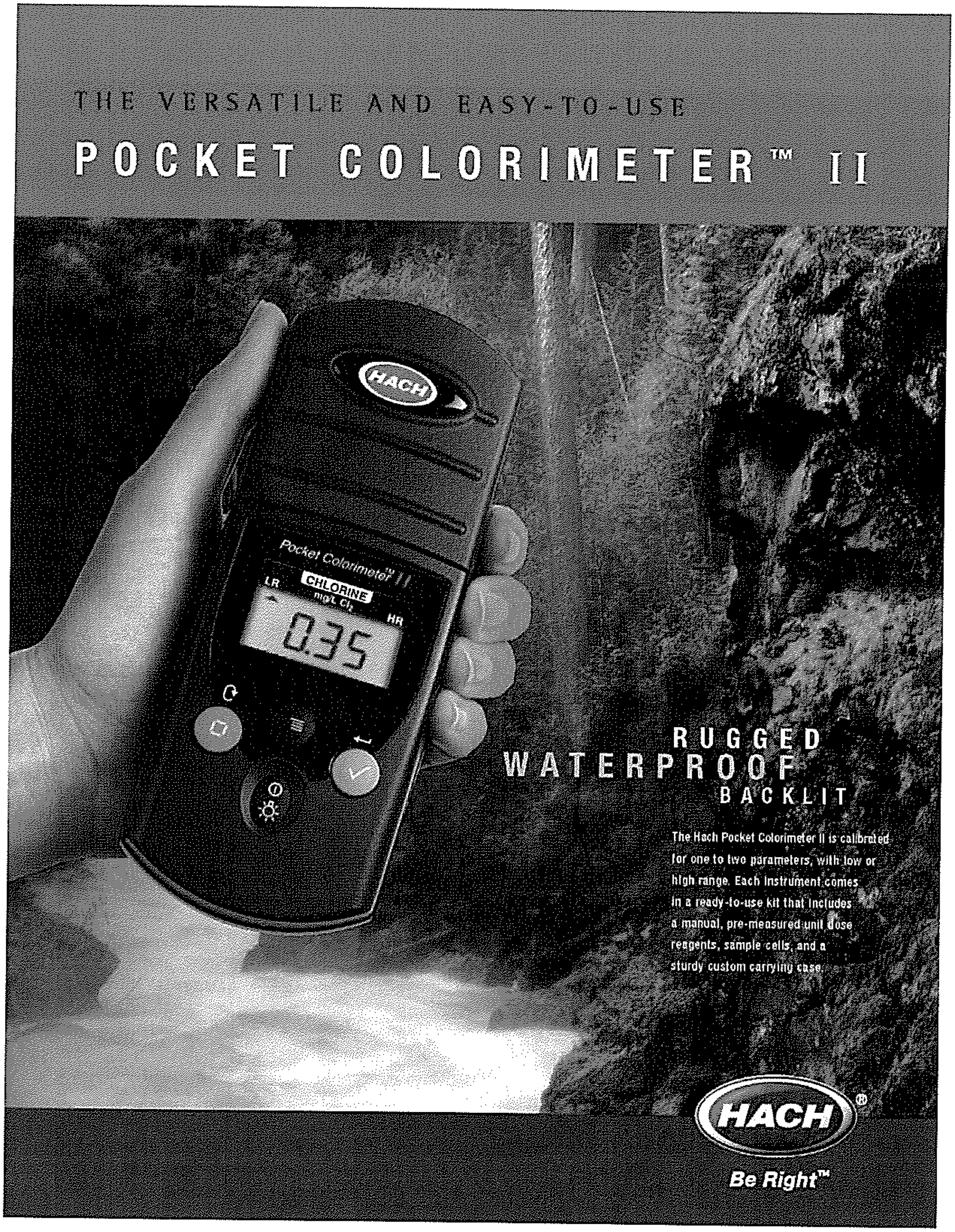
eba



Legend	A & R PLAN	CANADIAN ZINC CORPORATION
Existing Roads — SNP Sampling Locations	Scale: As Shown	PRAIRIE CREEK MINE
	Contour Interval: 125m	Figure 6:
	File Name: SNP Locations Map	SNP AND SITE LOCATION MAP
	Date: June 2005	

APPENDIX A

HACH PORTABLE UV SPECTROPHOTOMETER DESCRIPTION


THE VERSATILE AND EASY-TO-USE
POCKET COLORIMETER™ II
HACH
Pocket Colorimeter™ II
LR
CHLORINE
mg/L Cl2
HR
0.35
RUGGED
WATERPROOF
BACKLIT
The Hach Pocket Colorimeter II is calibrated for one to two parameters, with low or high range. Each instrument comes in a ready-to-use kit that includes a manual, pre-measured unit dose reagents, sample cells, and a sturdy custom carrying case.
HACH®
Be Right™

The Hach name means our products are simple, accurate, and supported with great service.

LANYARD

We have added a lanyard to keep the cap attached to the colorimeter. No more missing or dropped caps!

WATERPROOF

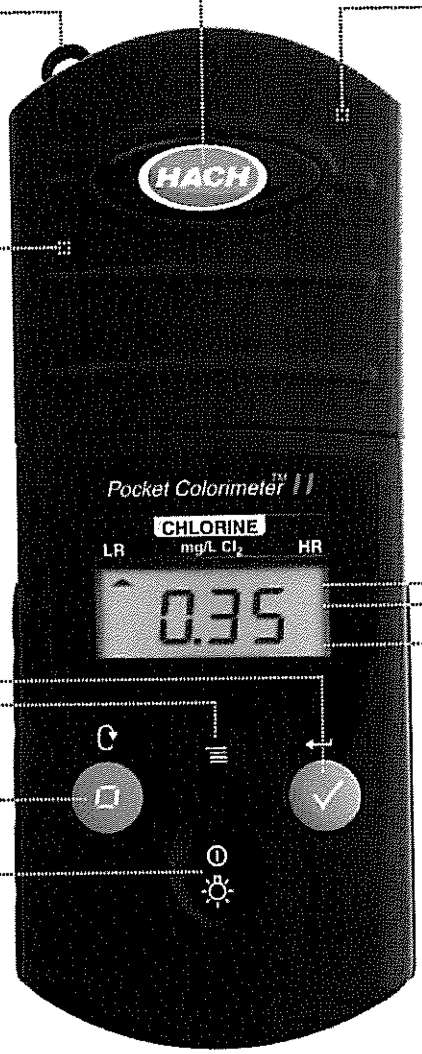
The IP67 rating means the Pocket Colorimeter II can stay submerged at 1 meter for 30 minutes and still function properly. It floats!

RUGGED CONSTRUCTION

A tough, impact-resistant shell protects the electronics and optics. Count on many years of trouble-free operation.

RANGE INDICATOR

The Range Indicator icon indicates either the instrument range or the parameter being tested. For many parameters, the instrument can measure in two different ranges.



SIMPLE, FAST USER INTERFACE

- Read/Enter Key- when measuring samples, press this key to read the concentration. Also used to confirm menu choices.
- Menu Key - quick, simple menu navigation and selection is just a key press away.
- Zero/Scroll Key - when measuring, press the Zero/Scroll Key to zero the instrument. Also scrolls through menu options.

DATALOGGING/ RECALL

Record the ten most recent data points and the time measurements were made. No more need to manually record data, saving you the time and hassle of carrying paper, pens, and a clipboard.

POWER/ BACKLIGHT KEY

The Power/Backlight Key turns the instrument on, and lets you backlight the large display, making it much easier to read in low light conditions (on demand).

BATTERY INDICATOR ICON

Battery life is significantly improved. The battery icon will tell you when you need to replace the batteries.

WE HAVE IMPROVED THE POCKET COLORIMETER BY ADDING NEW FEATURES, MAKING IT EVEN MORE VERSATILE AND EASIER TO USE.

SIMPLE AS EVER

We have added new features to the Pocket Colorimeter II, but it still has the same great advantages as the original. Hach Colorimeters put the accuracy and reliability of a lab instrument in the palm of your hand.

WATERPROOF, LIGHT WEIGHT AND ECONOMICAL

The Pocket Colorimeters can really be carried in your pocket! Weighing only .23 kg (8.1 oz.), the Pocket Colorimeter II is a low-cost instrument that anyone can use. It even floats!

ACCURATE, REPRODUCIBLE MEASUREMENTS

Wherever you are, the Pocket Colorimeter™ II offers accuracy and reproducibility comparable to expensive lab instruments, but is designed for a long working life in harsh conditions. A long-lasting LED is used as the light source.

PRE-PROGRAMMED

The instruments are factory programmed for one of more than 35 parameters; many are based on EPA-approved methods. No manual calibration is ever required. Simply zero the instrument with a blank, insert the reacted sample, and read the result. It's so easy.

BETTER OPTICS

The improved quality of the optical system allows for expanded ranges for ammonia, chlorine, chromium, copper, iron, and molybdenum, reducing the need for dilutions.

ANALYTE	OLD RANGE	NEW RANGE
AMMONIA	0-0.50 mg/L	0.01-0.80 mg/L
AMMONIA, FREE NEW!	—	0.02-0.5 mg/L
CHLORINE	0-5.00 mg/L	0.1-10.0 mg/L
CHROMIUM	0-0.50 mg/L	0.01-0.70 mg/L
COPPER	0-4.00 mg/L	0.04-5.00 mg/L
IRON, TPTZ	0-1.20 mg/L	0.01-1.70 mg/L
IRON, FERROVER	0-3.00 mg/L	0.02-5.00 mg/L
MOLYBDENUM	0-2.50/0-10.0 mg/L	0.02-3.00/0.1-12.0 mg/L

The ability to accept user calibrations is a first! It allows you to create your own calibration curve or perform a standard adjust.

The improved optics also expand the absorbance range of the instrument to 0-2.5 Abs.

We also manufacture wavelength-specific instruments so you can enter your own methods and calibrations using two to ten standards. Hach makes Spec√™ Standards to verify performance of nine different parameters. Check out our website for more info on the single wavelength colorimeters.

PARAMETERS FOR DRINKING WATER AND WASTEWATER

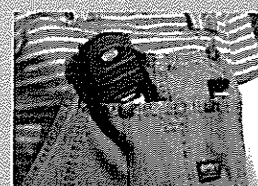
Aluminum	Iron, TPTZ
Ammonia	Lead, LeadTrak
Ammonia, Free	Manganese, High Range
Bromine	Manganese, Low Range
Chlorine, Free & Total	Monochloramine
Chlorine, F & T + pH	Nitrate
Chlorine Dioxide	Ozone
Copper	Phosphate
Dissolved Oxygen	Sulfate
Fluoride	Zinc
Iron, FerroVer	

PARAMETERS FOR ENVIRONMENTAL TESTING

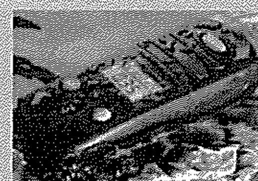
Ammonia	Nitrate
Dissolved Oxygen	Phosphate

PARAMETERS FOR INDUSTRIAL CONTROL

Ammonia	Nickel & Cobalt
Bromine	Nitrate
Chlorine	Ozone
Chlorine Dioxide	Phosphate
Chromium, Hexavalent	Phosphonate
Dissolved Oxygen	Silica
Iron, TPTZ	Zinc
Molybdate	



The compact size of the Pocket Colorimeter II makes it very portable and convenient.



The ability to float is just one of the great new features of the Pocket Colorimeter II.

HACH® Be Right™

Pocket Colorimeter™ II

SPECIFICATIONS***

POWER SUPPLY	4 AAA batteries; approximate life of 2000 tests (use of backlight reduces this number)
LAMP	Light Emitting Diode (LED)
DETECTOR	Silicon detector
WAVELENGTH	Fixed wavelength ±2 nm, varies with model
FILTER BANDWIDTH	15 nm
ABSORBANCE RANGE	0 to 2.5 Abs
DIMENSIONS	6.1 x 15.5 x 3.5 cm (2.45 x 6.2 x 1.4 in.)
NET WEIGHT	0.23 kg (0.5 lbs.)
OPERATING CONDITIONS	0 to 50° C; 0 to 90% relative humidity
SAMPLE CELL PATHLENGTH	1 cm and 22 mm
COMPLIANCE	European CE mark
DISPLAY	LCD, backlit
WARRANTY	2 years
ENCLOSURE	IP67, waterproof at 1m for 30 minutes

*** Subject to change without notice

ORDERING

Alachlor (PN 28129-00)
0.1, 0.5 ppb thresholds
Method: Immunoassay (18 tests)

Aluminum (PN 58700-25)
Range: 0.01-0.80 mg/L
Method: Aluminon (100 tests)

Ammonia (PN 58700-40)
Range: 0.01-0.80 mg/L
Method: Salicylate (100 tests)

Ammonia, Free and Monochloramine NEW! (PN 58700-26)
Free Ammonia Range: 0.02-0.50 mg/L
Method: Indophenol (50 tests)
Monochloramine Range:
0.04-4.50 mg/L as Cl_2
Method: Indophenol (100 tests)

Atrazine (PN 27635-00)
0.1, 0.5, 3.0 ppb thresholds
Method: Immunoassay (18 tests)

Bromine (PN 58700-01)
Range: 0.05-4.50/0.2-10 mg/L
Method: DPD (50-100 tests)

Chlorine, F* & T* ** (PN 58700-00)
Range: 0.02-2.00/0.1-8.0 mg/L
Method: DPD (50-100 tests)

Chlorine, F & T & pH
(PN 58700-12)
Range: 0.1-10.0 mg/L Cl_2
Method: DPD (100 tests)
Range: 6.0-8.5 pH
Method: Phenol Red (100 tests)

Chlorine, SwifTest Dispenser
(PN 58700-23) Free Chlorine *
(PN 58700-24) Total Chlorine * **
Range: 0.02-2.00 / 0.1-8.0 mg/L
Method: DPD (125-250 tests)

Chlorine Dioxide* (PN 58700-51)
Range: 0.05-5.00 mg/L
Method: DPD/Glycine (100 tests)

Chromium, Hexavalent**
(PN 58700-17)
Range: 0.01-0.70 mg/L
Method: 1,5 Diphenylcarbohydrazide
(100 tests)

Copper** (PN 58700-19)
Range: 0.04-5.00 mg/L
Method: Bicinchoninate (100 tests)

Fluoride* ** (PN 58700-05)
Range: 0.1-2.0 mg/L‡
Method: SPADNS (up to 50 tests)

Iron, FerroVer®**
(PN 58700-22)
Range: 0.02-5.00 mg/L
Method: FerroVer (100 tests)

Iron, TPTZ (PN 58700-16)
Range: 0.01-1.70 mg/L
Method: TPTZ (100 tests)

Lead, LeadTrak™ (PN 58700-21)
Range: 5-150 µg/L
Method: Fast Column Extraction
(20 tests)

Manganese, LR (PN 58700-18)
Range: 0.01-0.70 mg/L
Method: PAN (50 tests)

Manganese, HR** (PN 58700-15)
Range: 0.2-20.0 mg/L
Method: Periodate Oxidation (100 tests)

Metachlor (PN 28134-00)
0.5, 2.0 ppb thresholds
Method: Immunoassay (18 tests)

Molybdate (PN 58700-10)
Range: 0.02-3.00/0.1-12.0 mg/L
Method: Ternary Complex (100 tests)

Monochloramine and Free Ammonia (PN 58700-26)
Monochloramine Range:
0.04-4.50 mg/L as Cl_2
Method: Indophenol (100 tests)
Free Ammonia Range: 0.02-0.50 mg/L
Method: Indophenol (50 tests)

Nickel & Cobalt (PN 58700-20)
Range: 0.01-1.00 mg/L Ni
0.02-2.00 mg/L Co
Method: PAN (100 tests)

Nitrate (PN 58700-02)
Range: 0.4-30.0 mg/L as NO_3^-N
Method: Cadmium Reduction (100 tests)

Oxygen, Dissolved
(PN 58700-03)
Range: 0.2-10.0 mg/L
Method: HRDO (50 tests)

Ozone (PN 58700-04)
Range: 0.01-0.25/0.01-0.75 mg/L
Method: Indigo Trisulfonate
(up to 50 tests)

PCB in Soil (PN 27734-00)
1, 5, 10, 50 ppm thresholds
Method: Immunoassay (18 tests)

Phosphate* **(PN 58700-06)
Range: 0.02-3.00 mg/L
Method: PhosVer® 3 (100 tests)

Phosphonate
(PN 58700-07)
Range: 0.1-2.5/1-125 mg/L
Method: PhosVer 3 w/ UV Digestion
(100 tests)

Silica (PN 58700-34)
Range: 1-100 mg/L
Method: Silicomolybdate (100 tests)

Sulfate** (PN 58700-29)
Range: 2-70 mg/L
Method: Turbidimetric (100 tests)

TPH in Soil (PN 27750-00)
20, 50, 100, 200 ppm thresholds
Method: Immunoassay (18 tests)

TPH in Water (PN 27742-00)
2, 5, 10, 20 ppm thresholds
Method: Immunoassay (18 tests)

Zinc** (PN 58700-09)
Range: 0.02-3.00 mg/L
Method: Zincon (100 tests)

* Method is USEPA accepted or approved for drinking water (additional steps may be required)

** Method is USEPA accepted or approved for wastewater (additional steps may be required)

‡ Greater sensitivity (0.01 mg/L) is achieved by substituting bottled SPADNS reagent for the AccuVac Ampuls provided in this kit

HACH®

Be Right™

For current price information, technical support and ordering assistance, contact the Hach office or distributor serving your area.

In the United States, contact:

HACH COMPANY
P.O. Box 389
Loveland, Colorado 80539-0389
U.S.A.
Telephone: 800-227-4224
Fax: 970-669-2932
E-mail: orders@hach.com
www.hach.com

U.S. exporters and customers in Canada, Latin America, sub-Saharan Africa, Asia and Australia/New Zealand, contact:

HACH COMPANY World Headquarters
P.O. Box 389
Loveland, Colorado 80539-0389
U.S.A.
Telephone: 970-669-3050
Fax: 970-461-3939
E-mail: intl@hach.com
www.hach.com

In Europe, the Middle East and Mediterranean Africa, contact:

***HACH + LANGE** Europe*
Dr. Bruno Lange GmbH & Co. KG
Willstätterstraße 11
D-40549 Düsseldorf GERMANY
Telephone: +49 (0) 211 5288-0
Fax: +49 (0) 211 5288-143
E-mail: kundenservice@drlange.de
www.drlange.com

Lit No. 2441
D46

APPENDIX B

COLOURIMETRIC ZINC TEST METHOD

Zinc

✔Method 8009 — **Zincon Method***

Powder Pillows — **(0.01 to 2.00 mg/L)**

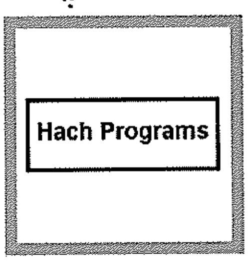
Scope and Application: For water and wastewater; digestion is required for determining total zinc (see *Digestion on page 1042*): USEPA Approved for wastewater analyses**

* Adapted from *Standard Methods for the Examination of Water and Wastewater.*
** *Federal Register,* 45(105) 36166 (May 29, 1980).

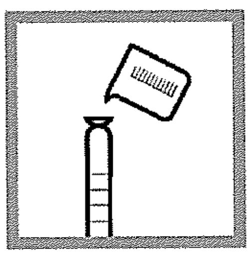
Tips and Techniques

- Caution! ZincoVer® 5 Reagent contains cyanide and is very poisonous if taken internally or if fumes are inhaled. Do not add to an acidic sample (pH < 4).
- Use only glass-stoppered cylinders in this procedure.
- Wash glassware with 1:1 HCl (Cat. No. 884-49) and rinse with deionized water before use.
- Wipe the outside of sample cells before each insertion into the instrument cell holder. Use a damp towel followed by a dry one to remove fingerprints or other marks.
- Use plastic droppers in this procedure. Droppers with rubber bulbs may contaminate the reagent.
- ZincoVer 5 reagent contains potassium cyanide. Cyanide solutions are regulated as hazardous wastes by the Federal RCRA. Cyanide should be collected for disposal as a reactive (D003) waste. Be sure that cyanide solutions are stored in a caustic solution with pH >11 to prevent release of hydrogen cyanide gas. See *Section 5* for further information on proper disposal of these materials.

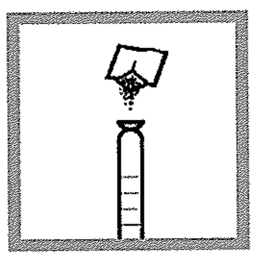
Powder Pillows — Method 8009



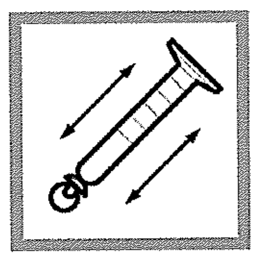
1. Touch **Hach Programs.** Select program **780 Zinc.** Touch **Start.**



2. Fill a 25-mL graduated mixing cylinder with 20 mL of sample.



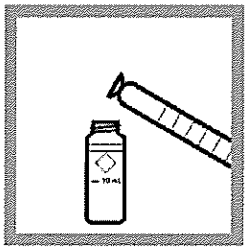
3. Add the contents of one ZincoVer 5 Reagent Powder Pillow to the cylinder. Stopper.



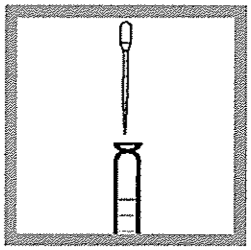
4. Invert several times to dissolve the powder completely. Inconsistent readings may result for low zinc concentrations if all the particles are not dissolved.

Note: The sample should be orange. If the sample is brown or blue, either the zinc concentration is too high, or an interfering metal is present. Dilute the sample and repeat the test.

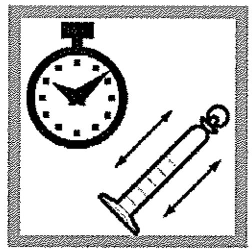
Zinc



5. Pour 10 mL of the solution into a sample cell (this is the blank).



6. Use a plastic dropper to add 0.5 mL of cyclohexanone to the remaining solution in the graduated cylinder.

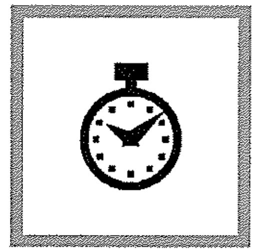


7. Touch the timer icon

Touch **OK**.

A 30-second reaction period will begin. During the reaction period, stopper the cylinder and shake vigorously (the prepared sample).

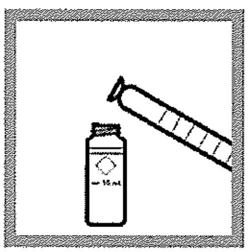
Note: The sample will be reddish-orange, brown, or blue, depending on the zinc concentration.



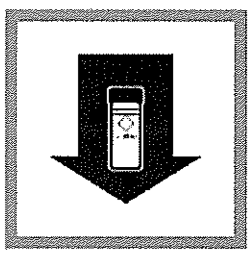
8. Touch the timer icon.

Touch **OK**.

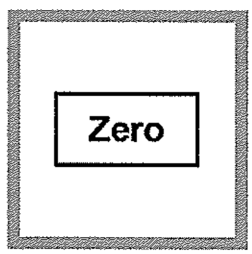
A three-minute reaction period will begin. During this reaction period, complete *step 9.*



9. Pour the solution from the cylinder into a round sample cell (this is the prepared sample).



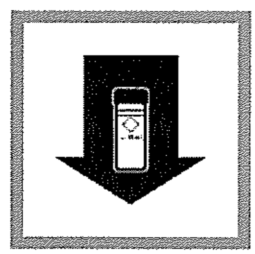
10. When the timer beeps, wipe the blank and place it into the cell holder.



11. Touch **Zero**.

The display will show:

mg/L Zn



12. Wipe the prepared sample and place it into the cell holder.

Results will appear in mg/L Zn.

Interferences

Interfering Substance	Interference Levels and Treatments
Aluminum	Greater than 6 mg/L
Cadmium	Greater than 0.5 mg/L
Copper	Greater than 5 mg/L
Iron (ferric)	Greater than 7 mg/L
Manganese	Greater than 5 mg/L
Nickel	Greater than 5 mg/L
Organic Material	Large amounts may interfere. Pretreat the sample with a mild digestion.
Highly buffered or extreme sample pH	May exceed the buffering capacity of the reagents and require sample pretreatment. Adjust pH to 4–5.

Samples containing amino-tri(methylene phosphonic acid) (AMP) will exhibit a negative interference. Perform a total phosphorus digestion (Method 8190) to eliminate this interference. IMPORTANT: Adjust the pH of the sample after the total phosphorus digestion to 4–5 with Sodium Hydroxide before analysis with the zinc test.

Sample Collection, Preservation, and Storage

Collect samples in acid-cleaned plastic or glass bottles. If prompt analysis is impossible, preserve the sample by adjusting to pH 2 or less with nitric acid (about 2 mL per liter). Preserved samples may be stored up to six months at room temperature.

Before analysis, adjust the pH to 4–5 with 5.0 N Sodium Hydroxide. Do not exceed pH 5 as zinc may precipitate. Correct the test result for volume additions; see *Section 3.1.3 Correcting for Volume Additions* on page 43.

Accuracy Check

Standard Additions Method (Sample Spike)

1. After reading test results, leave the sample cell (unspiked sample) in the instrument.
2. Touch **Options**. Touch **Standard Additions**. A summary of the standard additions procedure will appear.
3. Touch **OK** to accept the default values for standard concentration, sample volume, and spike volumes. Touch **Edit** to change these values. After values are accepted, the unspiked sample reading will appear in the top row. See *Standard Additions* in the instrument manual for more information.
4. Snap the neck off a Zinc Voluette® Ampule Standard, 25-mg/L Zn.
5. Prepare three sample spikes. Fill three mixing cylinders (Cat. No. 20886-40) with 20 mL of sample and use the TenSette® Pipet to add 0.1 mL, 0.2 mL, and 0.3 mL of standard, respectively to each sample and mix thoroughly.
6. Analyze each sample spike as described in the procedure above, starting with the 0.1 mL sample spike. Accept each standard additions reading by touching **Read**. Each addition should reflect approximately 100% recovery.

7. After completing the sequence, touch **Graph** to view the best-fit line through the standard additions data points, accounting for matrix interferences. Touch **View: Fit**, then select **Ideal Line** and touch **OK** to view the relationship between the sample spikes and the "Ideal Line" of 100% recovery.

See *Section 3.2.2 Standard Additions* on page *46* for more information.

Standard Solution Method

Prepare a 1.00-mg/L zinc standard solution as follows:

1. Using Class A glassware, pipet 10.00 mL of Zinc Standard Solution, 100-mg/L, into a 1000-mL volumetric flask. Dilute to the mark with deionized water. Prepare this solution daily. Perform the Zincon procedure as described above.
2. To adjust the calibration curve using the reading obtained with the 1.00-mg/L Zinc standard solution, touch **Options** on the current program menu. Touch **Standard Adjust**.

See *Section 3.2.4 Adjusting the Standard Curve* on page *49* for more information.

Digestion

Digestion is required if total zinc is being determined. The following is not the USEPA digestion (see *Section 4.1 USEPA-Approved Digestions* for more information).

a. If nitric acid has not been added to the sample previously, add 5 mL of Concentrated Nitric Acid (Cat. No. 152-49) to one liter of sample (use a glass serological pipet and pipet filler). If the sample was acidified at collection, add 3 mL of nitric acid to one liter of sample.
b. Transfer 100 mL of acidified sample to a 250-mL Erlenmeyer flask.
c. Add 5 mL of 1:1 Hydrochloric Acid (Cat. No. 884-49).
d. Heat sample on a Hot Plate (Cat. No. 12067-01, -02) for 15 minutes at 95 °C (203 °F). Make sure the sample does not boil.
e. Filter cooled sample through a membrane filter and adjust the volume to 100 mL with Deionized Water (Cat. No. 272-56).
f. Adjust the pH to 4–5 with 5.0 N Sodium Hydroxide (Cat. No. 2450-26) before analysis (see *Sample Collection, Preservation and Storage* for instructions).

Method Performance

Precision

Standard 1.00 mg/L Zn

Program	95% Confidence Limits of Distribution
780	0.95–1.05 mg/L Zn

See *Section 3.4.3 Precision* on page *53* for more information, or if the standard concentration did not fall within the specified range.

Sensitivity

Portion of Curve	ΔAbs	ΔConcentration
Entire Range	0.010	0.01 mg/L Zn

See *Section 3.4.5 Sensitivity* on page *54* for more information.

Summary of Method

Zinc and other metals in the sample are complexed with cyanide. Adding cyclohexanone causes a selective release of zinc. The zinc then reacts with 2-carboxy-2'-hydroxy-5'-sulfoformazyl benzene (zincon) indicator to form a blue-colored species. The blue color is masked by the brown color from the excess indicator. The intensity of the blue color is proportional to the amount of zinc present. Test results are measured at 620 nm.

Required Reagents

Description	Quantity Required Per Test	Unit	Cat. No.
Zinc Reagent Set, 20-mL sample size (100 tests = 100 samples + 100 blanks)			24293-00
Includes:			
Cyclohexanone	1 mL	100 mL MDB	14033-32
ZincoVer® 5 Reagent Powder Pillows	1 pillow	100/pkg	21066-69

Required Apparatus

Cylinder, graduated, mixing, 25-mL	1	each	20886-40
Sample Cells, 10-20-25 mL, w/cap	2	6/pkg	24019-06

Required Standards

Water, deionized		4 L	272-56
Zinc Standard Solution, 100-mg/L		100 mL	2378-42
Zinc Standard Solution, 2-mL PourRite® Ampule, 25-mg/L as Zn		20/pkg	14246-20
Zinc Standard Solution, 10-mL Voluette® Ampule, 25-mg/L as Zn		16/pkg	14246-10

HACH COMPANY
WORLD HEADQUARTERS
Telephone: (970) 669-3050
FAX: (970) 669-2932