- 0029

C/015/009 Incoming
#3355

COPY

ENERGY WEST MINING COMPANY
A SUBSIDIARY OF PACIFICORP

Energy West Mining Company
P. O. Box 310
15 No Main Street
Huntington, Utah 84528

September 29, 2009

Utah Coal Program
Division of Oil, Gas and Mining
1594 West North Temple, Suite 1210
P.O. Box 145801
Salt Lake City, Utah 84114-5801

Subject: **Clean Copy for the Trail Mountain Mine Mid-Term Review, PacifiCorp, Trail Mountain Mine, C015/0009, Task ID #3355, Emery County, Utah**

PacifiCorp, by and through its wholly-owned subsidiary, Energy West Mining Company ("Energy West") as mine operator, hereby submits the clean copies of Volume 2, Chapter 7 and the Legal and Financial Volume, Appendix A. These two copies were required by DOGM to be updated as part of the Trail Mountain Mine Mid-Term Review.

Enclosed are eight (8) copies each as required along with the required C1/C2 forms. If you have any questions or concerns regarding this document, please contact myself at (435) 687-4720 or Dennis Oakley at (435) 687-4825.

Sincerely,

Kenneth S. Fleck

Kenneth Fleck
Geology and Environmental Affairs Manager

Enclosure: C1/C2 Forms
Legal and Financial Volume – Appendix A (replace entire appendix)
Volume 2 – Chapter 7 Hydrology (replace entire chapter)

Cc: File

File in:
☐ Confidential
☐ Shelf
☒ Expandable
Refer to Record No 0029 Date 09292009
In C/015/009, Incoming
For additional information

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APPLICATION FOR COAL PERMIT PROCESSING

COPY

Permit Change ☒ New Permit ☐ Renewal ☒ Exploration ☐ Bond Release ☐ Transfer ☐

Permittee: PacifiCorp

Mine: Trail Mountain Mine **Permit Number:** C/015/0009

Title: Clean Copy Submittal for the Trail Mountain Mine Mid-Term Review

Description, Include reason for application and timing required to implement:

Instructions: If you answer yes to any of the first eight (gray) questions, this application may require Public Notice publication.

☐ Yes ☒ No 1. Change in the size of the Permit Area? Acres: _____ ☐ increase ☐ decrease.
☐ Yes ☒ No 2. Is the application submitted as a result of a Division Order? DO# _____
☐ Yes ☒ No 3. Does the application include operations outside a previously identified Cumulative Hydrologic Impact Area?
☐ Yes ☒ No 4. Does the application include operations in hydrologic basins other than as currently approved?
☒ Yes ☐ No 5. Does the application result from cancellation, reduction or increase of insurance or reclamation bond?
☐ Yes ☒ No 6. Does the application require or include public notice publication?
☒ Yes ☐ No 7. Does the application require or include ownership, control, right-of-entry, or compliance information?
☐ Yes ☒ No 8. Is proposed activity within 100 feet of a public road or cemetery or 300 feet of an occupied dwelling?
☐ Yes ☒ No 9. Is the application submitted as a result of a Violation? NOV # _____
☐ Yes ☒ No 10. Is the application submitted as a result of other laws or regulations or policies?
Explain: _____
☐ Yes ☒ No 11. Does the application affect the surface landowner or change the post mining land use?
☐ Yes ☒ No 12. Does the application require or include underground design or mine sequence and timing? (Modification of R2P2)
☐ Yes ☒ No 13. Does the application require or include collection and reporting of any baseline information?
☐ Yes ☒ No 14. Could the application have any effect on wildlife or vegetation outside the current disturbed area?
☐ Yes ☒ No 15. Does the application require or include soil removal, storage or placement?
☐ Yes ☒ No 16. Does the application require or include vegetation monitoring, removal or revegetation activities?
☐ Yes ☒ No 17. Does the application require or include construction, modification, or removal of surface facilities?
☐ Yes ☒ No 18. Does the application require or include water monitoring, sediment or drainage control measures?
☐ Yes ☒ No 19. Does the application require or include certified designs, maps or calculation?
☐ Yes ☒ No 20. Does the application require or include subsidence control or monitoring?
☒ Yes ☐ No 21. Have reclamation costs for bonding been provided?
☐ Yes ☒ No 22. Does the application involve a perennial stream, a stream buffer zone or discharges to a stream?
☐ Yes ☒ No 23. Does the application affect permits issued by other agencies or permits issued to other entities?

Please attach four (4) review copies of the application. If the mine is on or adjacent to Forest Service land please submit five (5) copies, thank you. (These numbers include a copy for the Price Field Office)

I hereby certify that I am a responsible official of the applicant and that the information contained in this application is true and correct to the best of my information and belief in all respects with the laws of Utah in reference to commitments, undertakings, and obligations, herein.

Kenneth Fleck
Print Name

Kenneth S. Fleck — Manager of Environmental Affairs — 9/29/09
Sign Name, Position, Date

Subscribed and sworn to before me this 29th day of Sept., 20 09

Chris M. Christensen
Notary Public

My commission Expires: April 24, 2011

Attest: State of Utah } ss:
County of Emery

NOTARY PUBLIC
CHRIS M CHRISTENSEN
51 N Main
Huntington, Utah 84528
My Commission Expires
April 24, 2011
STATE OF UTAH

For Office Use Only:	Assigned Tracking Number:	Received by Oil, Gas & Mining
		RECEIVED OCT 01 2009 DIV. OF OIL, GAS & MINING

Form DOGM- C1 (Revised March 12, 2002)

APPLICATION FOR COAL PERMIT PROCESSING
Detailed Schedule Of Changes to the Mining And Reclamation Plan

COPY

Permittee: PacifiCorp
Mine: Trail Mountain Mine **Permit Number:** C/015/0009
Title: Clean Copy Submittal for the Trail Mountain Mine Mid-Term Review

Provide a detailed listing of all changes to the Mining and Reclamation Plan, which is required as a result of this proposed permit application. Individually list all maps and drawings that are added, replaced, or removed from the plan. Include changes to the table of contents, section of the plan, or other information as needed to specifically locate, identify and revise the existing Mining and Reclamation Plan. Include page, section and drawing number as part of the description.

			DESCRIPTION OF MAP, TEXT, OR MATERIAL TO BE CHANGED
☐ Add	☒ Replace	☐ Remove	Volume 2, Chapter 7, entire chapter.
☐ Add	☒ Replace	☐ Remove	Legal and Financial Volume, Appendix A, entire Appendix
☐ Add	☐ Replace	☐ Remove	
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Any other specific or special instruction required for insertion of this proposal into the Mining and Reclamation Plan.

Received by Oil, Gas & Mining

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PacifiCorp

Energy West Mining Company

Trail Mountain Mine
C/015/0009

Mid-Term Review

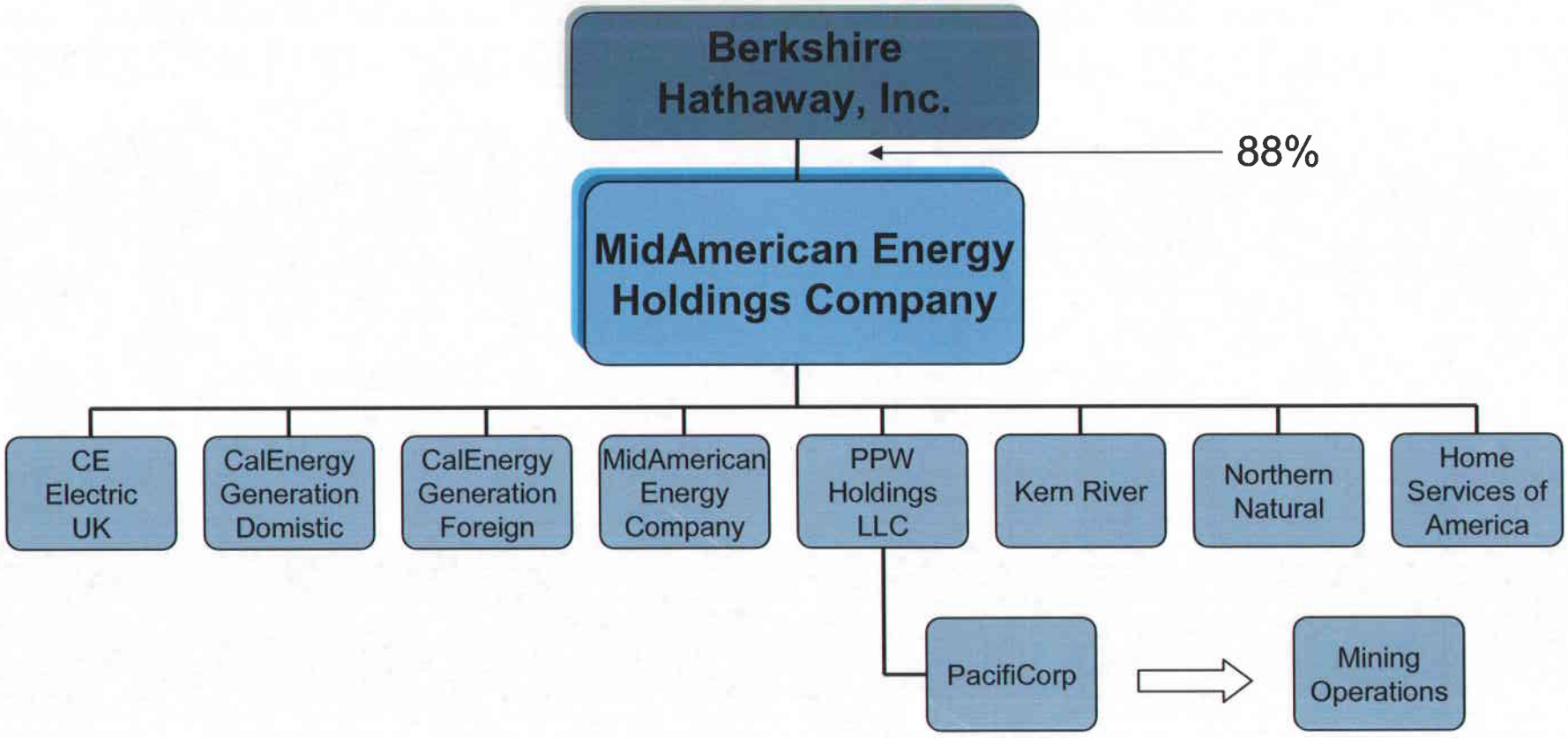
Clean Copy Submittal

Legal and Financial Volume – Appendix A
Replace Entire Appendix

ENERGY WEST MINING COMPANY
A SUBSIDIARY OF PACIFICORP

Corporate Structure

(As of June 16, 2006)



(1) Bridger Coal Co. is jointly owned 2/3 by Pacific Minerals, Inc., a subsidiary of PacifiCorp; and 1/3 by Idaho Energy Resources Company, a subsidiary of Idaho Power Company.

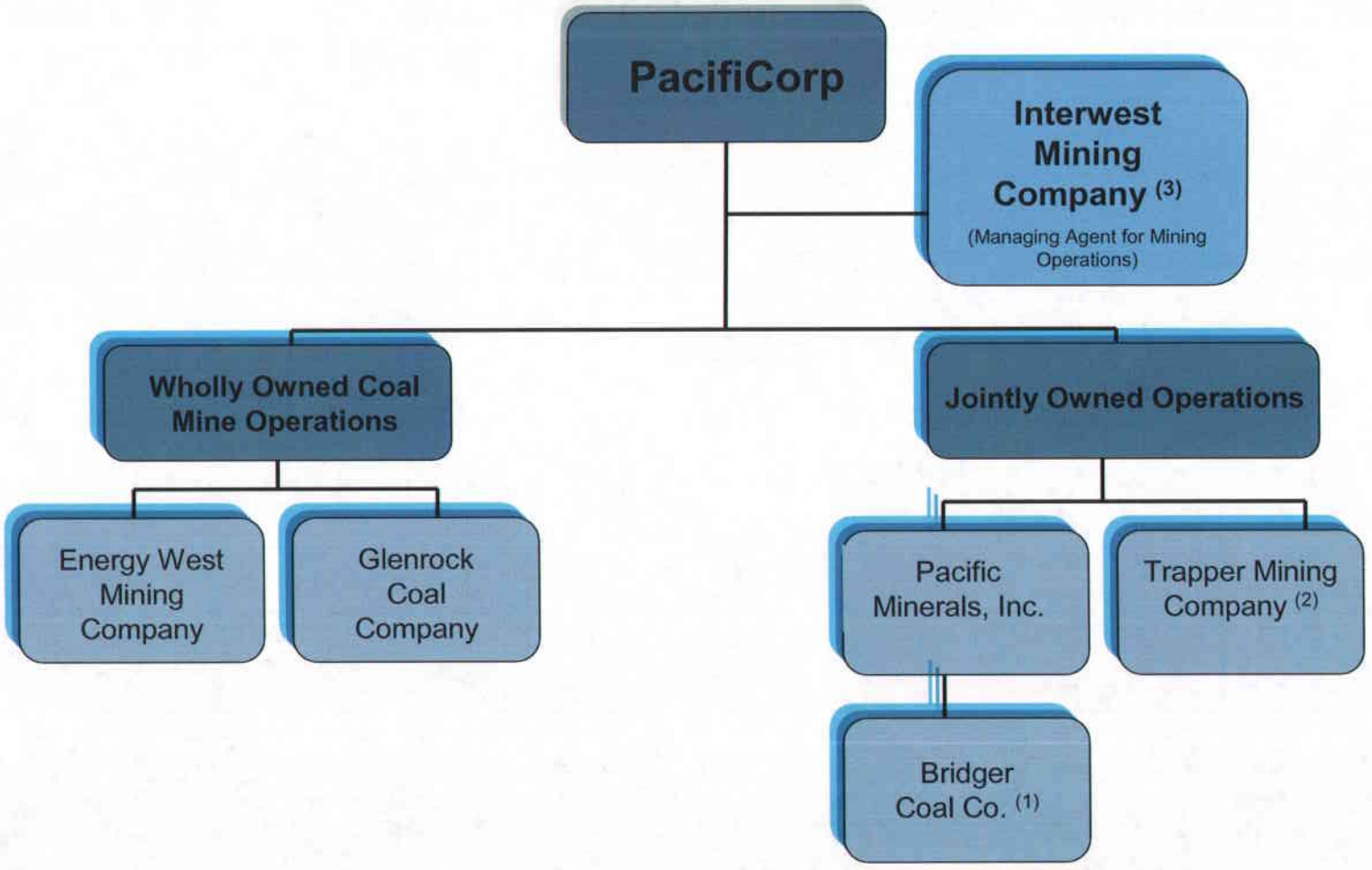
(2) PacifiCorp owns a 21.40% interest in Trapper Mines, Inc., which is operated by Trapper Mining, Inc., a Delaware non-stock corporation.

(3) Interwest Mining Company is a wholly owned subsidiary of PacifiCorp that provides management and technical support services to the mining companies with no ownership interest.

PacifiCorp's Mining Operations

(As of June 16, 2006)

Unless otherwise noted below, ownership is 100%



(1) Bridger Coal Co. is jointly owned 2/3 by Pacific Minerals, Inc., a subsidiary of PacifiCorp; and 1/3 by Idaho Energy Resources Company, a subsidiary of Idaho Power Company.

(2) PacifiCorp owns a 21.40% interest in Trapper Mines, Inc., which is operated by Trapper Mining, Inc., a Delaware non-stock corporation.

(3) Interwest Mining Company is a wholly owned subsidiary of PacifiCorp that provides management and support services to the mining companies with no ownership interest.

Current Listing of Officers and Directors

ENERGY WEST MINING COMPANY
A SUBSIDIARY OF PACIFICORP

BERKSHIRE HATHAWAY, INC. OFFICERS (as of March 26, 2008)			
Name	**Position**	**Address**	**Effective Date***
Warren E. Buffett	Chairman of the Board Chief Executive Officer	1440 Kiewit Plaza Omaha, Nebraska 68131	03/21/2006
Charles T. Munger	Vice Chairman of the Board of Directors	1440 Kiewit Plaza Omaha, Nebraska 68131	03/21/2006
Marc D. Hamburg	Vice President, Principal Financial Officer	1440 Kiewit Plaza Omaha, Nebraska 68131	03/21/2006
*In place on date of MidAmerican Energy Holdings Company acquisition of PacifiCorp effective March 21, 2006, unless noted otherwise.			

BERKSHIRE HATHAWAY, INC. DIRECTORS (as of March 26, 2008)			
Name	**Position**	**Address**	**Effective Date***
Warren E. Buffett	Chairman of the Board Chief Executive Officer	1440 Kiewit Plaza Omaha, Nebraska 68131	03/21/2006
Charles T. Munger	Vice Chairman of the Board of Directors	1440 Kiewit Plaza Omaha, Nebraska 68131	03/21/2006
Howard G. Buffett	Director	1440 Kiewit Plaza Omaha, Nebraska 68131	03/21/2006
Susan L. Decker	Director	1440 Kiewit Plaza Omaha, Nebraska 68131	05/05/2007
William H. Gates, III	Director	1440 Kiewit Plaza Omaha, Nebraska 68131	03/21/2006
David S. Gottesman	Director	1440 Kiewit Plaza Omaha, Nebraska 68131	03/21/2006
Charlotte Guyman	Director	1440 Kiewit Plaza Omaha, Nebraska 68131	03/21/2006
Donald R. Keough	Director	1440 Kiewit Plaza Omaha, Nebraska 68131	03/21/2006
Thomas S. Murphy	Director	1440 Kiewit Plaza Omaha, Nebraska 68131	03/21/2006
Ronald L. Olson	Director	1440 Kiewit Plaza Omaha, Nebraska 68131	03/21/2006
Walter Scott, Jr.	Director	1440 Kiewit Plaza Omaha, Nebraska 68131	03/21/2006
*In place on date of MidAmerican Energy Holdings Company acquisition of PacifiCorp effective March 21, 2006, unless noted otherwise.			

MIDAMERICAN ENERGY HOLDINGS COMPANY'S OFFICERS (as of April 18, 2008)			
Name	**Position**	**Address**	**Effective Date***
David L. Sokol	Chairman of the Board	1111 So. 103rd St. Omaha, NE 68214 (402) 231-1402	03/21/2006
Gregory E. Abel	President and Chief Executive Officer	666 Grand Avenue Des Moines, Iowa 50309	04/16/2008
Douglas L. Anderson	Senior Vice President, General Counsel and Corporate Secretary	1111 So. 103rd St. Omaha, NE 68214 (402) 231-1581	03/21/2006
Patrick J. Goodman	Senior Vice President and Chief Financial Officer	666 Grand Avenue Des Moines, Iowa 50309 (515) 242-4300	03/21/2006
Brent E. Gale	Senior Vice President , Regulation and Legislation	825 NE Multnomah, Suite 2000 Portland, Oregon 97232 (503) 813-5000	03/21/2006
Maureen E. Sammon	Senior Vice President and Chief Administrative Officer	666 Grand Avenue Des Moines, Iowa 50309 (515) 242-4300	03/21/2006
Cathy S. Woollums	Senior Vice President, Environmental Services and Chief Environmental Counsel	106 E. Second Street PO Box 4350 Davenport, Iowa 52808 (563)333-8009	02/12/2007
John "Jack" Diesing, Jr.	Vice President, Corporate Insurance AON Risk Services	P.O. Box 3307 Omaha, Nebraska 68103-3307 (402) 697-1400	03/21/2006
Steven R. Evans	Vice President Taxation	666 Grand Avenue Des Moines, Iowa 50309 (515) 242-4300	03/21/2006
Brian K. Hankel	Vice President and Treasurer	666 Grand Avenue Des Moines, Iowa 50309 (515) 242-4300	03/21/2006
Wayne F. Irmiter	Vice President and Controller	666 Grand Avenue Des Moines, Iowa 50309 (515) 242-4300	03/21/2006
Paul J. Leighton	Vice President Corporate Law, Assistant General Counsel & Assistant Corporate Secretary	4299 Northwest Urbandale Drive Urbandale, Iowa 50322-7916 (515) 281-2201	03/21/2006
Jonathan M. Weisgall	Vice President Federal Regulation/IPP	1200 New Hampshire Ave. NW, Suite 300 Washington, DC 20036-6812 (202) 828-1378	03/21/2006
Russell H. White	Vice President, General Services	666 Grand Avenue Des Moines, Iowa 50309 (515) 242-4300	03/21/2006
Mitchell L. Pirnie	Vice President and Chief Litigation Counsel	1111 So. 103rd St. Omaha, NE 68214 (402) 231-1527	02/12/2007

*In place on date of MidAmerican Energy Holdings Company acquisition of PacifiCorp effective March 21, 2006, unless noted otherwise.

MIDAMERICAN ENERGY HOLDINGS COMPANY'S DIRECTORS (as of September 20, 2007)			
Name	**Position**	**Address**	**Effective Date**
Gregory E. Abel	Director	666 Grand Avenue Des Moines, Iowa 50309 (515) 242-4300	03/21/2006
Warren E. Buffett	Director	1440 Kiewit Plaza Omaha, Nebraska 68131	03/21/2006
Marc D. Hamburg	Director	1440 Kiewit Plaza Omaha, Nebraska 68131	03/21/2006
Walter Scott, Jr.	Director	1440 Kiewit Plaza Omaha, Nebraska 68131	03/21/2006
David L. Sokol	Director	1111 So. 103rd St. Omaha, NE 68214 (402) 231-1400	03/21/2006
*In place on date of MidAmerican Energy Holdings Company acquisition of PacifiCorp effective March 21, 2006, unless noted otherwise.			

PPW HOLDINGS LLC OFFICERS (as of December 1, 2006)			
Name	**Position**	**Address**	**Effective Date***
Gregory E. Abel	President	666 Grand Avenue Des Moines, Iowa 50309 (515) 242-4300	05/23/2005
Steven R. Evans	Vice President Taxation	666 Grand Avenue Des Moines, Iowa 50309 (515) 242-4300	05/18/2006
Brian K. Hankel	Vice President and Treasurer	666 Grand Avenue Des Moines, Iowa 50309 (515) 242-4300	05/23/2005
Wayne F. Irmiter	Vice President and Controller	666 Grand Avenue Des Moines, Iowa 50309 (515) 242-4300	05/18/2006
Mitchell F. Ludwin	Vice President and Secretary	302 South 36th Street Omaha, Nebraska 68131 (402) 231-1587	05/18/2006
James C. Galt	Assistant Treasurer	666 Grand Avenue Des Moines, Iowa 50309 (515) 242-4300	05/18/2006
*In place on date of MidAmerican Energy Holdings Company acquisition of PacifiCorp effective March 21, 2006, unless noted otherwise.			

PACIFICORP'S OFFICERS (as of March 26, 2008)			
Name	**Position**	**Address**	**Effective Date***
Gregory E. Abel	Chairman of Board and Chief Executive Officer	666 Grand Avenue Des Moines, Iowa 50309 (515) 242-4300	03/21/2006
Dean S. Brockbank	Vice President and General Counsel, PacifiCorp Energy	1407 West North Temple Suite 320 Salt Lake City, Utah 84116 (801) 220-2000	08/30/2007
Jeffery B. Erb	Assistant Secretary	825 NE Multnomah, Suite 600 Portland, Oregon 97232 (503) 813-5000	03/13/2002
Natalie L. Hocken	Vice President and General Counsel, Pacific Power	825 NE Multnomah, Suite 1800 Portland, Oregon 97232 (503) 813-5000	01/01/2007
A. Robert Lasich	President, PacifiCorp Energy	1407 West North Temple Suite 320 Salt Lake City, Utah 84116 (801) 220-2000	08/30/2007
Mark C. Moench	Secretary	201 So. Main St. Suite 2400 Salt Lake City, UT 84111 (801) 220-2000	05/31/2007
Patrick J. Reiten	President, Pacific Power	825 NE Multnomah, Suite 1900 Portland, Oregon 97232 (503) 813-5000	09/15/2006
Douglas K. Stuver	Senior Vice President and Chief Finanial Officer	825 NE Multnomah, Suite 1900 Portland, Oregon 97232 (503) 813-5000	03/01/2008
A. Richard Walje	President, Rocky Mountain Power	201 So. Main St. Suite 2400 Salt Lake City, UT 84111 (801) 220-2000	03/21/2006
Bruce N. Williams	Vice President and Treasurer	825 NE Multnomah Suite 1900	05/17/2006
*In place on date of MidAmerican Energy Holdings Company acquisition of PacifiCorp effective March 21, 2006, unless noted otherwise.			

PACIFICORP'S DIRECTORS (as of March 26, 2008)			
Name	**Position**	**Address**	**Effective Date***
Gregory E. Abel	Director	666 Grand Avenue Des Moines, Iowa 50309 (515) 242-4300	03/21/2006
Douglas L. Anderson	Director	302 South 36th Street Omaha, Nebraska 68131 (402) 231-1642	03/21/2006
Brent E. Gale	Director	825 NE Multnomah, Suite 2000 Portland, Oregon 97232 (503) 813-5000	03/21/2006
Patrick J. Goodman	Director	666 Grand Avenue Des Moines, Iowa 50309 (515) 242-4300	03/21/2006
Natalie L. Hocken	Director	825 NE Multnomah, Suite 2000 Portland, Oregon 97232 (503) 813-5000	08/30/2007
A. Robert Lasich	Director	1407 West North Temple Suite 320 Salt Lake City, Utah 84116 (801) 220-2000	03/21/2006
Mark Moench	Director	201 So. Main St. Suite 2400 Salt Lake City, UT 84111 (801) 220-2000	03/21/2006
Patrick J. Reiten	Director	825 NE Multnomah, Suite 2000 Portland, Oregon 97232 (503) 813-5000	09/15/2006
A. Richard Walje	Director	201 So. Main St. Suite 2400 Salt Lake City, UT 84111 (801) 220-2000	07/02/2001
*In place on date of MidAmerican Energy Holdings Company acquisition of PacifiCorp effective March 21, 2006, unless noted otherwise.			

ENERGY WEST MINING COMPANY'S OFFICERS (as of July 1, 2009)			
Name	**Position**	**Address**	**Effective Date***
A. Robert Lasich	President	1407 West North Temple Suite 320 Salt Lake City, Utah 84116 (801) 220-2000	05/01/2008
Dean S. Brockbank	Vice President and General Counsel and Secretary	1407 West North Temple Suite 320 Salt Lake City, Utah 84116 (801) 220-2000	05/01/2008
Cindy A. Crane	Vice President	1407 West North Temple Suite 310 Salt Lake City, Utah 84116 (801) 220-2000	03/26/2009
Jeffery B. Erb	Assistant Secretary	825 NE Multnomah, Suite 1800 Portland, OR 97232 (503) 813-5000	10/01/2002
Bruce N. Williams	Treasurer	825 NE Multnomah, Suite 1900 Portland, OR 97232 (503) 813-5000	01/01/1992
Tanya S. Sacks	Assistant Treasurer	825 NE Multnomah, Suite 1900 Portland, OR 97232 (503) 813-5000	02/01/2001
*In place on date of MidAmerican Energy Holdings Company acquisition of PacifiCorp effective March 21, 2006, unless noted otherwise.			

ENERGY WEST MINING COMPANY'S DIRECTORS (as of July 1, 2009)			
Name	**Position**	**Address**	**Effective Date***
A. Robert Lasich	Director	1407 West North Temple Suite 320 Salt Lake City, Utah 84116 (801) 220-2000	05/01/2008

*In place on date of MidAmerican Energy Holdings Company acquisition of PacifiCorp effective March 21, 2006, unless noted otherwise.

Summary Listing of Officers and Directors (Past and Present)

ENERGY WEST MINING COMPANY
A SUBSIDIARY OF PACIFICORP

BERKSHIRE HATHAWAY, INC. OFFICERS (as of March 26, 2008)			
Name	**Position**	**Effective Date***	**Departure Date**
Warren E. Buffett	Chairman of the Board Chief Executive Officer	03/21/2006	Current
Charles T. Munger	Vice Chairman of the Board of Directors	03/21/2006	Current
Marc D. Hamburg	Vice President, Principal Financial Officer	03/21/2006	Current

*In place on date of MidAmerican Energy Holdings Company acquisition of PacifiCorp effective March 21, 2006, unless noted otherwise.

BERKSHIRE HATHAWAY, INC. DIRECTORS (as of March 26, 2008)			
Name	**Position**	**Effective Date***	**Departure Date**
Current Directors			
Warren E. Buffett	Chairman of the Board Chief Executive Officer	03/21/2006	Current
Charles T. Munger	Vice Chairman of the Board of Directors	03/21/2006	Current
Howard G. Buffett	Director	03/21/2006	Current
Susan Decker	Director	05/05/2007	Current
William H. Gates, III	Director	03/21/2006	Current
David S. Gottesman	Director	03/21/2006	Current
Charlotte Guyman	Director	03/21/2006	Current
Donald R. Keough	Director	03/21/2006	Current
Thomas S. Murphy	Director	03/21/2006	Current
Ronald L. Olson	Director	03/21/2006	Current
Walter Scott, Jr.	Director	03/21/2006	Current
Past Directors			
Malcolm G. Chace	Director	03/21/2006	05/05/2007
Daniel J. Jaksich	Controller	03/21/2006	09/26/2007

*In place on date of MidAmerican Energy Holdings Company acquisition of PacifiCorp effective March 21, 2006, unless noted otherwise.

MIDAMERICAN ENERGY HOLDINGS COMPANY'S OFFICERS (as of June 30, 2009)			
Name	**Position**	**Effective Date***	**Departure Date**
Current Officers			
David L. Sokol	Chairman of the Board	03/21/2006	Current
	Chief Executive Officer	03/21/2006	04/16/2008
Gregory E. Abel	President and Chief Executive Officer	04/16/2008	Current
	President and Chief Operating Officer	03/21/2006	04/16/2008
Douglas L. Anderson	Senior Vice President, General Counsel	03/21/2006	Current
Patrick J. Goodman	Senior Vice President and Chief Financial Officer	03/21/2006	Current
Brent E. Gale	Senior Vice President , Regulation and Legislation	03/21/2006	Current
Maureen E. Sammon	Senior Vice President and Chief Administrative Officer	03/21/2006	Current
Cathy S. Woollums	Senior Vice President, Environmental Services and Chief Environmental Counsel	02/12/2007	Current
	Vice President	03/21/2006	02/12/2007
John "Jack" Diesing, Jr.	Vice President, Corporate Insurance AON Risk Services	03/21/2006	Current
Steven R. Evans	Vice President Taxation	03/21/2006	Current
Brian K. Hankel	Vice President and Treasurer	03/21/2006	Current
Wayne F. Irmiter	Vice President and Controller	03/21/2006	Current
Paul J. Leighton	Vice President Corporate Law, Assistant General Counsel & Assistant Corporate Secretary	03/21/2006	Current
Jonathan M. Weisgall	Vice President Federal Regulation/IPP	03/21/2006	Current
Russell H. White	Vice President, General Services	03/21/2006	Current
Mitchell L. Pirnie	Vice President and Chief Litigation Counsel	02/12/2007	Current

*In place on date of MidAmerican Energy Holdings Company acquisition of PacifiCorp effective March 21, 2006, unless noted otherwise.

MIDAMERICAN ENERGY HOLDINGS COMPANY'S OFFICERS (as of June 30, 2009)			
Name	**Position**	**Effective Date***	**Departure Date**
Past Officers			
William J. Fehrman	Senior Vice President, Regulation and Legislation	03/21/2006	03/21/2006
Keith D. Hartje	Senior Vice President	03/21/2006	05/15/2007
Mark C. Moench	Senior Vice President	03/21/2006	03/21/2006

*In place on date of MidAmerican Energy Holdings Company acquisition of PacifiCorp effective March 21, 2006, unless noted otherwise.

MIDAMERICAN ENERGY HOLDINGS COMPANY'S DIRECTORS (as of September 20, 2007)			
Name	**Position**	**Effective Date***	**Departure Date**
Gregory E. Abel	Director	03/21/2006	Current
Warren E. Buffett	Director	03/21/2006	Current
Marc D. Hamburg	Director	03/21/2006	Current
Walter Scott, Jr.	Director	03/21/2006	Current
David L. Sokol	Director	03/21/2006	Current

*In place on date of MidAmerican Energy Holdings Company acquisition of PacifiCorp effective March 21, 2006, unless noted otherwise.

PPW HOLDINGS LLC OFFICERS (as of December 1, 2006)			
Name	**Position**	**Effective Date***	**Departure Date**
Gregory E. Abel	President	05/23/2005	Current
Steven R. Evans	Vice President Taxation	05/18/2006	Current
Brian K. Hankel	Vice President and Treasurer	05/23/2005	Current
Wayne F. Irmiter	Vice President and Controller	05/18/2006	Current
Mitchell F. Ludwin	Vice President and Secretary	05/18/2006	Current
James C. Galt	Assistant Treasurer	05/18/2006	Current

*In place on date of MidAmerican Energy Holdings Company acquisition of PacifiCorp effective March 21, 2006, unless noted otherwise.

PACIFICORP'S OFFICERS (as of May 1, 2008)			
Name	**Position**	**Effective Date***	**Departure Date**
Current Officers			
Gregory E. Abel	Chairman of Board and Chief Executive Officer	03/21/2006	Current
Dean S. Brockbank	Vice President and General Counsel, PacifiCorp Energy	08/30/2007	Current
Jeffery B. Erb	Assistant Secretary	03/13/2002	Current
Natalie L. Hocken	Vice President and General Counsel, Pacific Power	01/01/2007	Current
A. Robert Lasich	President, PacifiCorp Energy	08/30/2007	Current
	Vice President and General Counsel	03/21/2006	08/30/2007
Mark C. Moench	Secretary	05/31/2007	Current
Patrick J. Reiten	President, Pacific Power	09/15/2006	Current
Douglas K. Stuver	Senior Vice President and Chief Finanial Officer	03/01/2008	Current
A. Richard Walje	President, Rocky Mountain Power	03/21/2006	Current
Bruce N. Williams	Vice President and Treasurer	5/17/06	Current
	Treasurer	02/16/2000	5/17/06

*In place on date of MidAmerican Energy Holdings Company acquisition of PacifiCorp effective March 21, 2006, unless noted otherwise.

PACIFICORP'S OFFICERS (as of May 1, 2008)			
Name	**Position**	**Effective Date***	**Departure Date**
Past Officers			
Barry G Cunningham	Sr. Vice President	02/11/2002	05/23/2006
William Fehrman	President, PacifiCorp Energy	03/21/2006	08/30/2007
Donald A. Furman	Sr. Vice President	07/02/2001	06/03/2005
Andrew P. Haller	Sr. V.P. , General Counsel and Corporate Secretary	6/4/2001 12/11/2000	12/31/2006
Michael G. Jenkins	Assistant Secretary	05/12/1999	5/17/2006
Judth Johansen	President and Chief Executive Officer	06/04/2001	03/20/2006
Robert A. Klein	Sr. Vice President	08/06/2001	12/26/2005
Douglas A. Kusyk	Assistant Secretary	04/01/2005	05/17/2006
William D. Landels	Executive Vice President	11/29/1999	03/31/2004
Jeffery K. Larsen	Vice President	08/22/2002	09/10/2004
Donald (Doug) Larson	Vice President	07/02/2001	05/17/2006
Andrew N. MacRitchie	Executive Vice President	06/04/2001	03/20/2006

*In place on date of MidAmerican Energy Holdings Company acquisition of PacifiCorp effective March 21, 2006, unless noted otherwise.

PACIFICORP'S OFFICERS CONTINUED (as of May 1, 2008)			
Name	**Position**	**Effective Date***	**Departure Date**
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David J. Mendez	Sr. V.P. and Chief Financial Officer	08/22/2006	02/29/2008
Robert A. Moir	Sr. Vice President	01/11/2002	03/31/2004
Richard D. Peach	Sr. V.P. and Chief Financial Officer	8/22/06 3/21/2006	11/22/2006
Michael J. Pittman	Sr. Vice President	05/19/1993	07/07/2005
Tanya S. Sacks	Assistant Treasurer	06/04/2001	05/17/2006
Alexander D. Tait	Assistant Secretary	06/04/2001	04/01/2004
Stan K. Watters	Sr. Vice President	9/15/06 3/21/06 6/3/03	3/16/07 9/15/06 3/20/06
Ernest E. Wessman	Vice President	03/21/2006	05/17/2006
Matthew R. Wright	Executive Vice President	01/01/2002	03/20/2006

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Douglas L. Anderson	Director	03/21/2006	Current
Brent E. Gale	Director	03/21/2006	Current
Patrick J. Goodman	Director	03/21/2006	Current
Natalie L. Hocken	Director	08/30/2007	Current
A. Robert Lasich	Director	03/21/2006	Current
Mark Moench	Director	03/21/2006	Current
Patrick J. Reiten	Director	09/15/2006	Current
A. Richard Walje	Director	07/02/2001	Current
Past Directors			
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Stephen Dunn	Director	11/2005	03/20/2006
William J. Fehrman	Director	03/21/2006	08/30/2007
Andrew P. Haller	Director	5/2003	12/31/2006
Judith A. Johansen	Director	12/2000	03/20/2006
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Matthew R. Wright	Director	7/2001	03/20/2006

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Current Officers			
A. Robert Lasich	President	05/01/08	Current
	Vice President, General Counsel and Secretary	12/01/06	04/30/2008
Dean S. Brockbank	Vice President, General Counsel and Secretary	05/01/2008	Current
Cindy A. Crane	Vice President	03/26/2009	Current
Jeffery B. Erb	Assistant Secretary	10/01/2002	Current
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Past Officers			
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Andrew P. Haller	Senior Vice President, General Counsel and Secretary	2/2001	11/30/2006
Dee W. Jense	President	10/2002	11/30/2006
Robert P. King	Vice President	2/2001	08/15/2006
Larry O. Martin	Assistant Secretary	2/0001	06/15/2006

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ENERGY WEST MINING COMPANY'S DIRECTORS (as of July 1, 2009)			
Name	**Position**	**Effective Date***	**Departure Date**
Current Directors			
A. Robert Lasich	Director	05/01/08	Current
Past Directors			
Niel L. Getzelman	Director	12/01/2006	04/30/2008
Dee W. Jense	Director	10/2002	11/30/2006
Robert P. King	Director	2/2001	08/15/2006

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Energy West Mining Company

Trail Mountain Mine
C/015/0009

Mid-Term Review

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ENERGY WEST MINING COMPANY
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CHAPTER 7

HYDROLOGY

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HYDROLOGY

7.1 GROUNDWATER HYDROLOGY

7.1.1 Scope

The scope of the groundwater section of this report is to describe the existing groundwater hydrologic conditions of the mine plan and adjacent areas and to describe the methods that have been and will be used to predict and monitor the impacts from mining (see Figure 7-1 for location of the Trail Mountain Permit Area). Sections within the groundwater section of this report will cover the following major topics: methodology, existing groundwater resources, groundwater hydrologic balance, mitigation and control plans, and groundwater monitoring plans.

7.1.2 Methodology

Information used in preparing the groundwater hydrologic section of this report has been gathered by field investigations conducted on the ground and in the mine. Water quality samples have been collected and analyzed. Pertinent literature has been examined. In addition, experience of personnel working in the mine has been utilized to obtain estimates of the quantity of water encountered in the mine.

A seep and spring survey was conducted on October 29, 1985 in the vicinity of lease UTU-64375 (previously referred to as Tract 2). Data collected from this survey are supplemental to data collected in June 1981 as part of the investigation conducted for leases U-49332, U-082996, ML-22603 (previously referred to as Tract 1) for the PAP.

All water quality samples have been and will continue to be analyzed by a certified laboratory. Water rights were determined by examining current records of the Utah Division of Water Rights.

7.1.3 Existing Groundwater Resources

This section of the report deals with the groundwater resources of the mine plan area as well as the region as a whole.

7.1.3.1 Regional Groundwater Hydrology

Geology, an important factor in the groundwater hydrology, is discussed briefly in this section to provide a basis for better understanding of the groundwater hydrologic regime.

Geology - The Trail Mountain Mine plan area is located in the central portion of the Wasatch Plateau coal field (Doelling, 1972). The dip of the strata is generally toward the southwest, ranging from approximately five to eleven percent (three to six degrees) over the mine plan area.

The geologic formations exposed on or adjacent to the mine plan are Cretaceous members of the Mesaverde group, overlain by the North Horn and Flagstaff Limestone formations, which are Tertiary Formations (see Plate 6-2).

Star Point Sandstone - The Star Point Sandstone, the basal formation of the Mesaverde group (Doelling, 1972), is a light colored, massive, medium to fine-grained sandstone (Spieker, 1931). The Star Point ranges in thickness from 250 to 450 feet (Doelling, 1972, and Spieker, 1931). The sandstone is relatively impermeable with groundwater movement occurring mainly in fractures.

Blackhawk Formation - Overlying the Star Point is the Blackhawk Formation which is the middle and coal-bearing division of the Mesaverde group. The Blackhawk consists of alternating sandstone, shale and coal beds and is approximately 700 to 800 feet thick with the valuable coal seams located within the lower 400 feet (Doelling, 1972).

The sandstone beds are fine to medium-grained (Spieker, 1931) and yellow-gray to tan in color (Doelling, 1972). The sands of the Blackhawk are cemented by calcium carbonate or silica with the exception of a few localized areas in which the cement consists almost entirely

of clay. Iron is also present in the cement of all but the pure white sandstones (Spieker, 1931). The generally discontinuous nature of the Blackhawk and apparent low specific yield (Cordova, 1964) indicates that the water yielding capabilities of the Blackhawk are only of local importance.

Spieker (1931) identifies three general types of shale in the Blackhawk Formation: ordinary clay shale, carbonaceous shale, and smoke-gray shale (all continental in origin). The ordinary clay shale is gray to green, granular and normally soft at the outcrop; the carbonaceous shale is brown to black, massive and laminated; and the smoke-gray shale is tough and leathery, and in its unweathered state is hard and homogeneous (Spieker, 1931). The presence of shale acts as a significant barrier to the vertical movement of water within the Blackhawk Formation.

Castlegate Sandstone - The Castlegate Sandstone, generally considered a member of the Price River Formation (Spieker, 1931), consists of massive, medium to coarse-grained sandstone beds, containing conglomerate with a matrix of grit (Doelling, 1972) in places. The Castlegate overlies the Blackhawk Formation, and its beds are occasionally broken by sandy, hard, gray shale and at times by thin lenses of coal (Doelling, 1972).

Price River Formation - The lithologic characteristics of both the Price River Formation and the underlying Castlegate Sandstone are similar. The Castlegate member is separated from the Price River due to its cliff-forming characteristics (Spieker, 1931). Like the Castlegate, the Price River Formation consists of medium- to coarse-grained sandstone beds with occasional lenses of shale. Although the unit has a high porosity, its apparent low permeability (Cordova, 1964) reduces its water-yielding capabilities except through fractures.

North Horn Formation - The youngest geologic formation within the mine plan area is the North Horn Formation. The North Horn is the lowermost member of the Wasatch Group, consisting of variegated shales, irregular beds of gray, brown or cream-colored sandstone of various texture and thin beds of steel gray and cream-colored limestone (Spieker, 1931).

Like the Blackhawk Formation, the shales in the Castlegate, Price River, and North Horn formations act as significant barriers to the vertical movement of water within the formations; therefore, a significant portion of the water which reaches these underlying formations percolates downward until encountering a shale layer, which then causes horizontal movement to the surface or another "drain," i.e., sandstone finger within the formation.

Flagstaff Limestone - Although not located within the mine plan area, erosional remnants of the Flagstaff Limestone are located on summits and ridges adjacent to the Trail Mountain Mine (Davis and Doelling, 1977). The unit forms a white cliff, consisting of white, light gray and thin-bedded lacustrine limestone with some thin beds of gray shale and white volcanic ash. On top of Trail Mountain in the NW 1/4 of Section 22, T17S, R6E the thickness of the Flagstaff Limestone was measured at 105 feet (Davis and Doelling, 1977).

Faults - No major faults have been found to extend into the mine plan area. The Joe's Valley fault zone, trending north to south, is located approximately three miles to the west of the mine plan area; therefore, no major faults are anticipated to be encountered in the Trail Mountain Mine.

Groundwater - The principal factor controlling the occurrence and availability of groundwater in any area is geology. As noted by Price and Waddell (1973), nearly all of the region surrounding the mine plan area is underlain by rocks of continental and marine origin, consisting predominantly of interbedded sandstones and shales. Although some of the sandstones in the region serve as the principal water-bearing strata, their ability to yield water for extended periods of time is largely controlled by the existence of the relatively impermeable interbedded shale layers, which prevent the downward movement of a significant amount of water.

According to the US Geological Survey (1979), groundwater in the region exists under water table, artisan, and perched conditions. Water table conditions exist primarily in shallow

alluvial deposits along larger perennial streams and in relatively flat lying sedimentary rocks. Artisan conditions exist at greater depths where a confining layer overlies a more permeable member; however, pressures are generally not sufficient to produce flowing wells. Perched or impeded conditions exist where the confining layer lies beneath the water-bearing stratum.

As noted by Lines (1985), the Blackhawk Formation and the Star Point Sandstone are considered together in the region as an aquifer. These formations are typically saturated where they exist sufficiently far from the edges of canyons; however, the Blackhawk Formation tends to be drained near the canyons, as is the case in the existing Trail Mountain Mine workings.

Strata that overly the Blackhawk Formation are not completely saturated but do contain perched aquifers (Lines, 1985), which provide water locally to springs and baseflow to some streams.

Investigations in the vicinity of the Trail Mountain Mine by Danielson et al (1981) indicated that most, if not all, groundwater in the region is derived from snowmelt. Recharge tends to be limited in areas underlain by younger rocks due to slope steepness and relative imperviousness, both of which promote runoff rather than infiltration of snowmelt.

The predominant chemical constituents in most springs in the region are calcium, magnesium, and bicarbonate (Lines, 1985). Dissolved solids concentrations generally range from about 250 to 750 milligrams per liter. Regionally, the concentrations of major dissolved constituents in water from individual geologic units are highly variable, due to lithologic complexity in the area.

Spring inventories of the mine plan area were conducted in 1981 and 1985. The springs within and adjacent to the mine plan area, shown in Plate 7-1, exist under perched conditions because of the existence of relatively impermeable interbedded shales within the North Horn, Price River, Castlegate and Blackhawk Formations. Springs issue from a sandstone layer underlain by shale adjacent to and downslope from a local recharge basin where more than

average snow can accumulate. Recharge zones for these local springs are nearby flats along ridges. Springs generally do not occur along narrow ridges with steep side slopes where little opportunity for groundwater recharge exists.

Another interesting groundwater characteristic deals with the origin of springs with regard to geologic formations. The springs sampled on Trail Mountain were associated with the North Horn Formation. As mentioned previously, the North Horn Formation consists of variegated shale, sandstone, and thin-bedded limestone. The shale layers act as impeding members to deep percolation, diverting a significant portion of water which percolates through the soil mantle and forcing it to move somewhat horizontally to be discharged at the surface as spring water. Most of the springs are located at higher elevations. The North Horn Formation lacks distinct and persistent lithologic units (Spieker, 1931); therefore, the sandstone of water-bearing lenses of the formation is somewhat discontinuous. This fact, coupled with the fact that recharge zones for the springs are in the nearby flats along the ridges, implies that springs are local in extent as opposed to a larger more regional system.

7.1.3.2 Mine Plan Area Aquifers

Seeps and Springs - As indicated previously, springs and seeps within and adjacent to the mine plan area have been inventoried. The mine plan area was walked over and springs and seeps identified. Water quality samples were collected from the springs associated with the mine plan area and analyzed.

Springs on Trail Mountain generally issue from sandstone overlying a shale layer. Lines (1985) found that the laboratory hydraulic conductivity of the sandstone and shale units within the Blackhawk Formation varies by four to six orders of magnitude. The relative magnitude of the hydraulic conductivity of local sandstones compared with siltstones and shales indicates that the finer grained sediments of the formations serve as barriers to the downward movement of water.

Recharge into local formations, either through snowmelt, rainfall, or subsurface seepage from an adjacent formation, percolates downward within the sandstone beds; however, upon

reaching a less-permeable siltstone or shale layer, the water is forced to flow downdip to the surface, issuing at the interface between the two units. Four wells have been drilled to monitor groundwater conditions in the Star Point Sandstone. The following table lists the well completion data and the status of each well:

WELL ID.	DRILL DEPTH (ft)	STRATA MONITORED	POTENTIMETRIC ELEVATION (ft)	MONITORING STATUS
TM-1	650	Star Point Sandstone (See Notes Below)	7259	Abandoned Relocated to TM-1B (See Notes Below)
TM-1B	480	Star Point Sandstone (See Notes Below)	7272	Monthly See Monitoring Plan
TM-2	60	Spring Canyon Member Star Point Sandstone	7151	Abandoned In-Mine Well Area Sealed
TM-3	560	Spring Canyon Member Star Point Sandstone	6900	Monthly See Monitoring Plan

Well TM-1: Well TM-1 was drilled outside the mine near the main manway portal. The hole was drilled to a total depth of 650 feet, beginning at a point 5.0 feet below the top of the Star Point Sandstone. At this location the Star Point was encountered to a depth of 350 feet, with a transition from the Star Point to the Mancos Shale existing from a depth of 350 feet to 500 feet. Below the 500-foot depth, the Mancos shale is present. The elevation of the ground surface at TM-1 is 7276.0 feet. On September 17, 1993 the static water level in TM-1 was at a depth of 17.4 feet below the surface; hence, the elevation of the potentiometric surface at TM-1 is 7258.6 feet. During routine monitoring on December 20, 1993 the bailer utilized to retrieve the quality samples became lodged in the casing at a depth of approximately forty feet. Several unsuccessful attempts were made to retrieve the bailer. Well TM-1 will be permanently abandoned using Division of Water Rights specifications. Monitoring potential impacts to the Star Point Sandstone at the mine facility was transferred to Well TM-1B on June 22, 1994.

Well TM-1B: Beaver Creek Coal developed a surface well located near the bathhouse (designated as well TM-1B on the enclosed Surface Facilities map 3-1) with the intended

purpose of supplying water to the water treatment plant (see Volume 2 Appendix 7-7). During well development it was determined that the well production was insufficient to supply the water treatment plant (production was less than five gallons per minute) and the well was temporarily abandoned. Well TM-1B was drilled in October 1987 to a depth of 480 feet, which fully penetrated the Star Point Sandstone formation. Development included setting 480 feet of 6 inch steel casing, perforating the casing from 380-460, and setting a grundfos 5-10 GPM pump at 420 feet with a 1 inch galvanized discharge line. Monitoring of well TM-1B was initiated in June 1994 with depth on a monthly basis and quality collected quarterly.

Well TM-2: Well TM-2 was an in-mine well drilled at crosscut 54 in the south mains. The hole was drilled to a total depth of 60 feet, beginning at the top of the Star Point. Only the Spring Canyon Member of the Star Point Sandstone was penetrated in this hole. The elevation of the mine floor and the top of the Star Point Sandstone at TM-2 is 7167.0 feet. On October 24, 1985 the static water level in TM-2 was at a depth of 16.5 feet below the mine floor. Hence, the elevation of the potentiometric surface at this location is 7150.5 feet.

Well TM-3: PacifiCorp drilled and developed well TM-3 on September 28, 1993 to satisfy a special condition request from the mid-term permit review. Results of an aquifer test conducted April 28, 1994 can be found in Appendix 7. Well TM-3 was drilled in Straight Canyon, approximately 11 miles northwest of Orangeville, Utah (SW1/4 NW1/4 of Section 3, Plate 7-2). Well TM-3 was drilled to a total depth of 560 feet. At this location, the Star Point was encountered to a depth of 455 feet, with a transition from the Star Point - Spring Canyon Member to the Mancos Shale existing from a depth of 555 feet to 560 feet. The elevation of the ground surface at TM-3 is 6750 feet. Water in the Star Point Sandstone is under artisan pressure, with the static pressure on June 22, 1994 of 65 psi. Hence, the elevation of the potentiometric surface at TM-3 is 6900.2 feet.

Results of complete chemical analyses from Well TM-1B are presented with other water monitoring data in the Annual Reports. Plate 7-1 also shows the elevation of the

potentiometric surface in the greater Trail Mountain Mine area. This data is taken from Lines (1985) and modified using data from Wells TM-1, TM-1B, TM-2 and TM-3. As noted, the potentiometric surface surmised by Lines should be shifted to the south in the vicinity of Cottonwood Creek. Plate 7-1 indicates that the flow of groundwater in the Star Point Sandstone in the vicinity of the Trail Mountain Mine is to the south-southwest toward Straight Canyon. Springs in the vicinity of the Trail Mountain Mine are used by cattle, deer, elk and other wildlife. Five of the springs (T-4, T-6, T-8, T-9, T-11, T-15) have been developed with watering troughs or ponds.

Data presented by Lines (1985) indicate that the total dissolved solids concentrations of water from springs in the North Horn Formation tend to increase in the direction of groundwater flow, i.e., in the south-southwest direction according to Lines, (1985). A review of TDS data collected from springs monitored by PacifiCorp substantiates this observation (review Annual Hydrologic Monitoring Reports, Springs T-8, T-15 and T-6). The pattern of increasing TDS in a southerly direction could possibly be due to increased leaching of the bedrock in the down gradient direction or contact with altered strata associated with natural burning along the southern outcrop. Insufficient springs were available to determine if such a tread exists within other formations in the vicinity of the mine; however, Lines (1985-Appendix 7-B) found that the pattern did not exist in the Blackhawk-Star Point aquifer.

The pH of water issuing from springs in the survey area showed no trends. Values varied from 7.3 to 8.5, generally falling in the range of 7.3 to 7.6; hence, spring water in the study area is slightly alkaline.

Groundwater Quality - Water quality samples have been collected from seepage within the Trail Mountain Mine to determine the groundwater hydrologic conditions within the Blackhawk Formation in which the coal-bearing zone is located. Water quality samples have also been collected from springs to provide an index of groundwater hydrologic conditions within other overlying formations of the mine plan area.

All samples were collected and preserved as previously outlined. The results of the chemical analyses for samples taken from within the mine are presented in Table 7-1.

Wells and Users - As indicated previously, no wells are known to exist within or adjacent to the mine plan area except for the wells drilled to monitor potential impacts to the Star Point Sandstone aquifer. Principal groundwater use in the general area is restricted to use of wildlife and for stockwatering from springs or seeps. Groundwater produced within the mine is used for dust suppression and equipment operation within the mine or discharged under an approved UPDES permit (see Appendix 7).

7.1.4 Groundwater Development and Mine Dewatering

This section of the report discusses the groundwater supply and usage in the mine plan and adjacent areas as well as the dewatering taking place in the Trail Mountain Mine.

7.1.4.1 Water Supply

Water required for underground mining operations is supplied from two sources:

1. Underground water from the mine is collected in a sump and recirculated for mining purposes; and

2. Supplemental mine water needs can also be supplied by pumping water from Cottonwood Creek.

Culinary water is supplied from underground sources pumped to a water treatment plant located near the main portal.

Water Rights - A search of water rights from the Utah Division of Water Rights within and adjacent to the mine plan area showed no claimed groundwater rights within two miles.

7.1.4.2 Mine Dewatering

Generally water encountered within the mine has been in the form of roof leakers through bolt holes and tension cracks positioned parallel to the working face of the mine. As mining progresses downdip, leakers further than 500 feet updip of the working face generally dry up. Only a limited amount of water is made within the mine. Water produced within the mine is used for dust suppression and fire protection within the mine and for the operation of in-mine machinery. Occasionally mine water production will exceed usage because of inactivity of the mine operation, shortlived surges of inflow, etc. As a result, a system has been constructed to allow for discharge of the mine water from the sump to Cottonwood Creek, with an option of routing the discharge through the sediment pond if necessary. This discharge point is approved under an UPDES Discharge Permit and is fitted with a flow meter for accurate quantity measurement. Intercepted groundwater will be monitored, quantified and reported annually in the Hydrologic Monitoring Report.

7.1.5 Effects of Mining on the Groundwater Hydrologic Balance

As has been noted, the occurrence and quality water in any region is highly controlled by geology. A structural feature known as the Straight Canyon Syncline may influence the groundwater hydrology in the northwestern corner of the permit area. The axis of the syncline, plunging NE-SW at approximately 3.5°, passes just to the northwest of the permit boundary and is visible on outcrop at the Joe's Valley dam. The syncline is a prominent feature and could provide a conduit from groundwater migration from NE-SW. The only data for this area has been obtained from exploration holes which have been drilled near the syncline axis. No unusual or persistent sources of groundwater at the coal seam horizon were noted in holes TMX-2, TMX-6, and TMX-7 (see Appendix 7). As with any syncline structure, increased amounts of intercepted groundwater could be expected as mining approaches the syncline axis. Rather than rapid inundation which can occur along fault zones, a gradual increase in the amount groundwater entering the mine should be anticipated as mining proceeds downdip below the potentiometric surface toward the syncline axis. Since excess water in the mine is stored in sumps, settled and pumped out into Cottonwood Canyon Creek, the net loss to the general hydrologic regime would be minor or zero. The entire Trail Mountain permit area is within the

Cottonwood drainage system. Interbasin transfer will not occur from the interception and discharging of groundwater.

Springs - As noted previously, springs within and surrounding the mine plan area were inventoried in June, 1981 and October 1985. Experience gained from the data collected at nearby mines and from the general area has provided vital information regarding the possible effect of mining on springs.

Plate 7-1 shows the location of all water sources found during the hydrologic inventory of the mine plan and adjacent area. As shown, only a limited number of springs/seeps were found on the east face of Trail Mountain. The springs located were mainly confined to the west slopes of the mountain.

Based on the data collected by PacifiCorp and the Bureau of Mines on the adjacent East Mountain property, mining induced impacts have not been identified. As discussed in Chapter 11, subsidence is expected to have no impact on bedrock-aquifer springs in the vicinity of the Trail Mountain Mine.

Four run-off fed ponds were also identified during the October 29, 1985 survey. Their locations are shown on Plate 7-1. These ponds, numbered 35-1P, 26-1P, 26-2P and 26-3P, were sampled for water quality during the 1981 survey and occur within the area of potential subsidence. The subsidence effects on the ponds may result in changes in retention capacity if subsidence fractures intercept them; however, water quality is not likely to be adversely affected.

Inflows to the mine are projected to be insufficient to require other than occasional dewatering; hence, impacts due to dewatering are projected to be minimal. The water supply for use at the mine (culinary and domestic) is obtained from in-mine sources.. Lines (1985) states that mining is not expected to adversely impact water quality in the vicinity of the Trail Mountain Mine.

7.1.6 Mitigation and Control Plans

As was previously discussed, no significant impacts to the groundwater system are expected from the mining operation. The groundwater monitoring plan (discussed in the following

section) will provide a means to follow the possible effect of the mining activities on the groundwater system.

Any roads, fences, stock ponds, earth dams, or water troughs which are materially damaged by subsidence will be repaired and regraded to restore them to their pre-subsidence usefulness. Should significant subsidence impacts occur, the applicant will restore to the extent technologically and economically feasible those surface lands that were reduced in reasonably foreseeable use as a result of such subsidence to a condition capable of supporting reasonable foreseeable uses that such lands were capable of supporting before subsidence.

7.1.6.1 Alternative Water Supply

In order to restore any land affected by Applicant's mining operations to a condition capable of supporting the current and postmining land uses stated herein, the Applicant will replace water determined to have been lost or adversely affected as a result of Applicant's mining operations if such loss or adverse impact occurs prior to final bond release. The water will be replaced from an alternative source in sufficient quantity and quality to maintain the current and postmining land uses as stated herein.

During the course of regular monitoring activities required by the permit, or as the Applicant otherwise acquires knowledge, the Applicant will advise the Division of the loss or adverse occurrence discussed above, within ten working days of having determined that it has occurred. Within ten days after the Division notifies Applicant in writing that it has determined that the water loss is the result of the Applicant's mining operation, the Applicant will meet with the Division to determine if a plan for replacement is necessary and, if so, establish a schedule for submittal of a plan to replace the affected water. Upon acceptance of the plan by the Division, the plan shall be implemented. Applicant reserves the right to appeal the Division's water loss determinations as well as the proposed plan and schedule for water replacement as provided by Utah Code Ann. 40-10-22(3)(a).

7.1.7 Groundwater Monitoring Plan

An inventory of the springs adjacent to the mine plan area was conducted during the spring of 1981 and the fall of 1985. Water quality and quantity data were collected at springs throughout the mine plan and adjacent area. After the quantity and quality data was assembled, representative springs were selected for the groundwater monitoring program. These springs are shown in Plate 7-2.

Groundwater monitoring for the permit area will also consist of collecting water quality and quantity from points of significant inflow to the underground workings. An inventory of the active portion of the mine will be conducted on a quarterly basis to identify the location and geologic occurrence of mine inflows that exceed three gallons per minute. Certain of these inflows, if they occur, will be selected, in consultation with DOGM, for continued monitoring. Samples from all monitoring stations will be collected and analyzed according to Appendix 7-1. Groundwater monitoring data collected during a calendar year will be summarized and submitted to DOGM in the Annual Report. Monitoring parameters will be in accordance with DOGM Guidelines for Groundwater Monitoring. Monitoring schedule and reporting will be in accordance with Appendix 7-1.

7.1.7.1 Baseline Monitoring

Baseline monitoring will be conducted on new sites for a two year period, after which monitoring will revert to the operational parameters list in the Division's guidelines. In addition, all sites, both groundwater and surface water, will be sampled and analyzed for baseline parameters every fifth year (see Appendix 7 for groundwater and surface water locations and frequencies).

7.1.7.2 Operational Monitoring

When two years of baseline data have been collected, the monitoring frequency will be adjusted according to DOGM's guidelines and as shown in Appendix 7-1 for Operational Phase Monitoring.

Mine water and sediment pond discharge will be monitored in accordance with the approved UPDES permit.

7.1.7.3 Post-Mining Monitoring

Post-mining monitoring of groundwater will continue on representative springs, which will be determined with the aid and approval of the UDOGM. Quantity and quality monitoring and analysis will be accomplished biannually for the time period associated with the reclamation bond or until post-mining data approaches preliminary standards. Parameters to be monitored will be selected following consultation with the State and Federal agencies.

7.2 SURFACE WATER HYDROLOGY

As was explained under Section 7.1, OSM and DOGM regulations require that water monitoring programs be established in areas of underground coal mining to monitor the effects of mining activities and protect the hydrologic balance of such area. This section outlines the surface water hydrologic investigation conducted on the permit area.

7.2.1 Scope

The scope of the surface water section of this report is to describe the existing hydrologic conditions of the mine plan and adjacent areas and to describe the methods that have been and will be used to predict, monitor and mitigate the impacts of mining. Sections within this section will cover the following major topics: methodology, existing surface water resources, surface water development, control and diversions, effects of mining on the surface water hydrologic balance, mitigation and control plans, and surface water monitoring plans.

7.2.2 Methodology

Information used in preparing the surface water hydrologic section of this report has been gathered by field investigations. Pertinent literature has been examined. Numerous water quality samples have been and will continue to be analyzed by a certified laboratory. Water rights have been determined by examining current records of the Utah Division of Water Rights.

The mean annual water yield from the Trail Mountain Mine plan area was calculated by two separate methods and compared with an estimate of the mean annual water yield given in Jeppson et al. (1968) to increase the level of confidence. The first method of calculation, referred to as "Grunsky's Rule," was originally developed by Grunsky (1908) and later adapted by Sellars (1965). In accordance with this method, the average annual water yield can be determined from:

$$Q = \propto P^2 \text{ [for } P \leq 1/(2)] \quad (7\text{-}1)$$

or

$$Q = P - 1/4(\propto) \text{ [for } P \geq 1/(2)] \quad (7\text{-}2)$$

Where "Q" is the mean annual water yield, in inches; "P" is the normal annual precipitation, in inches; and "$\propto$"is the runoff coefficient, in inches^{-1}. Alpha ($\propto$) was determined from guidelines set forth by Hawkins (1976). The second method of calculation is known as Ol'deKop's formula (Sellars, 1965). According to this method, the mean annual water yield is determined from:

$$Q = P - E_o \tanh \frac{P}{E_o}$$

where " Q" and "P" are as previously defined and "E_o" is the annual potential evapotranspiration, in inches.

Estimates of peak flow recurrence intervals for ephemeral streams in the mine plan area were determined from techniques presented by Fields (1975). According to Fields (1975), the 25 and 50 year recurrence interval flood discharge of Utah streams is related to channel geometry characteristics. In this USGS investigation Utah was subdivided into three areas, which were defined from information collected at 85 gaging stations. The locations of the sites used to develop the three appropriate equation sets were of similar streamflow characteristics. Thirty-three sites were studied at mountainous locations in east central Utah [see Figure 2, Fields (1975)] designated as Area 2. Analysis of the data provided reliable estimating equations for flood flows with 25 and 50 year recurrence intervals. Specifically, for the mine plan area, the following relationships were found to apply:

$$q25 = 3.7W^{1.57} \quad (7\text{-}4)$$

and

$$q50 = 3.9W^{1.58} \quad (7\text{-}5)$$

where "W" is the width of the channel bar cross-section in feet, and 25 and 50 are the 25 and 50-year recurrence interval flood discharges in cfs, respectively. The respective standard errors associated with Equations 7-4 and 7-5 are 28 and 33 percent.

The runoff volume resulting from a particular rainfall depth was determined using the runoff curve number technique, as defined by the US Soil Conservation Service (1972). According to the curve number methodology, the algebraic and hydrologic relationship between storm rainfall, soil moisture storage, and runoff can be expressed by the equations;

$$S = \frac{1000}{CN} - 10 \quad (7\text{-}6)$$

and

$$Q = \frac{(P - 0.2S)^2}{P + 0.8S} \quad (7\text{-}7)$$

where "Q" is the direct runoff volume in inches, "P" is the storm rainfall depth in inches, "S" is a watershed storage factor in inches (defined as the maximum possible difference between "P" and "Q"), and "CN" is a dimensionless expression of "S" referred to as the curve number. Curve number values were chosen using information supplied by the U.S. Soil Conservation Service (1972), Hawkins (1973), and personal hydrologic judgment following field observations. Weighted curve numbers were used for heterogeneous areas. Kent (1973) gives CN values for the four different hydrologic soil groups and different land use descriptions. The mine site disturbed area has soil characteristics with average runoff potential, i.e., between groups B and C. Land use consists of 70% fair condition range land at CN avg. = 74, 25% industrial area at CN avg. - 89.5, and 5% dirt road at CN avg. = 84.5 (see Table 7-2). The disturbed area weighted

CN was found to be 78.5 [from (0.70) (74) = (0.25) (89.5) = (0.05) (84.5)]. The side canyon has soil characteristics with moderately high runoff potential, group C, because of shallow soils and ledges. The area is 85% fair condition range land at CN=79 and 15% poor condition range land at CN=86. This yields a weighted CN for the side canyon of 80 [from (0.85 (79) + (0.15(86)]. This drainage area of North Cottonwood Canyon is moderately low runoff potential soil, group B, and 2/3 good woods and 1/3 good range which are characterized by CN's of 55 and 61 respectively. The weighted CN is 57 [from (0.67)(55) + (0.33) (61)]. Values of "P" were obtained for selected durations and return periods from Miller et. al. (1973). A 24-hour storm was used for design purposes.

The undisturbed area draining to the sediment pond is predominantly from the soil types classified as Rockland and Stony Sandy Loam, which contain the Grassland Shrub Community. Although these areas do have rock ledges, they are located nearer to the canyon bottom and have slightly flatter slopes and more vegetation between rock outcrops. Based on the soil types (Sandy Loam) and vegetation (Grassland-Shrub), the runoff curve number of 72 is selected based on range land in fair condition, hydrologic soil group between B&C and forest land, thin stand, poor cover, no mulch hydrologic soil group between B&C.

Equation 7-6 is based upon the assumption $I_a = 0.2S$, where I_a is the initial abstraction from storm rainfall, defined as the rainfall which must fall before runoff begins, (i.e., to satisfy interception, evaporation and soil-water storage; therefore, determination of runoff from Equation 7-6 is valid only when P I_a or P 0.2S. No runoff can occur below this point.

Estimates of the peak discharge to be expected from various precipitation events were made using the unit hydrograph procedure developed by the US Soil Conservation Service 1972). Figure 7-2 shows a runoff hydrograph and the associated terminology.

A hyetograph of a single block of rainfall excess with duration D is shown in the upper portion of the figure. The lower portion of the figure contains the resultant runoff hydrograph. For runoff from excess rainfall, the area under the hydrograph curve and the area enclosed by the rainfall

hyetograph represent the same volume of water (Q). The peak flow rate for the hydrograph is represented by "Q_p", while "t_p" represents the time to peak flow from the start of the hydrograph to "Q_p". The base time (t^b) is the duration of the hydrograph. The time from the center of mass of rainfall excess to the peak of the runoff hydrograph is the lag time (t_L).

The time of concentration (t_c), not shown on Figure 7-2, is defined as the time for flow from the hydraulically most remote point in a basin to reach the basin outlet.

Time to peak, t_p, is assumed to be a function of watershed lag (t_L) which is determined according to the equation:

$$t_L = \frac{(l^{0.8})(S+1)^{0.7}}{1900Y^{0.5}} \qquad (7\text{-}8)$$

where t_L is the watershed lagtime in hours, l is the hydraulic length or the length of the mainstream to the farthest divide in feet, "S" is as previously defined, and "Y" is the average watershed slope in percent. Values of "Y" were obtained by using methods outlined by Craig and Rankl (1977). The hydraulic length was taken from an appropriate topographic map while "S" was determined from Equation 7-7 once the runoff curve number was estimated. According to the US Soil Conservation Service (1972), the watershed lag time is equal to $0.6t_C$ and the time of concentration (t_C) is equal to 1.5 t_p.

Combining these two expressions, it can be seen that:

$$t_p = 1.11\ t_L \qquad (7\text{-}9)$$

where both variables are as previously defined.

The peak discharge constant used in the dimensionless unit hydrograph method is determined according to the equation:

$$q_p = \frac{484AQ}{t_p} \tag{7-10}$$

where "q_p" is the unit hydrograph peak flow rate in cubic feet per second, "A" is the drainage area in square miles, "Q" is the runoff volume in inches (as determined by Equation 7-6), "t_p" is as previously defined in hours, and 484 is a conversion factor. The rainfall distribution for the 24-hour storm duration was generated from the theoretical NOAA Type II storm distribution shown in Figure 7-3.

Dimensionless unit hydrographs are developed by simulating many natural unit hydrographs using the time to peak and the peak discharge constant. Haan (1970) proposed a dimensionless unit hydrograph based on the gamma function:

$$\frac{q(t)}{qp} = \frac{rt \times e^{1-t/t_p} C_3 t_p}{t_p} \tag{7-11}$$

where "q(t)" is the hydrograph ordinate at time "t", "q_p" and "t_p" are as previously defined, and "C_3"
is a parameter defined by:

$$Q = q_p t_p \left[\frac{e}{C_3 t_p}\right] C_3 t_p \times T\left(C_3 t_p\right) \tag{7-12}$$

where "Q" is the runoff volume (one inch for a unit hydrograph) and represents the gamma function.

Figure 7-4 shows how the shape of the hydrograph defined by equation 7-11 changes as "C_3t_p" changes. The higher the value of "C_3t_p", the sharper the peak of the hydrograph. The hydrograph for the disturbed area runoff of 0.75 inches was determined to have a shape with characteristics t_L

= 0.08 hr., t_p = 0.09 hr., and q_p = 20.1 cfs. These results are associated with a "C_3 t_p" factor of 3.0 or a "C_3" of 43. Similar evaluations were made for the hydrograph of Cottonwood and Side Canyon runoffs and are given in Table 7-7.

The dimensionless unit hydrograph method involves the development of a runoff hydrograph from a complex rainstorm. The storm is divided into blocks of uniform intensity of duration D. Values of D must be less than or equal to t_p. Practically, the selection of D as a multiple of t_p will ensure that the peak will be encountered. Rainfall excess is generated from the rainfall depths of duration D and the rainfall-runoff relationship expressed in equation 7-6. The rainfall excess from each increment D is then multiplied by the unit hydrograph ordinates to produce a component hydrograph. Each of the component hydrographs are then lagged by a time increment D and are concurrently summed to produce the synthetic runoff hydrograph. A more complete discussion of the unit hydrograph method can be found in Chow (1964) or Haan and Barfield (1977).

Following the determination of a given peak discharge, design sizes for culverts used for runoff diversions and conveyance were determined using methods derived by the US Soil Conservation Service (1972) and illustrated in Figure 7-5.

Sedimentation storage requirements were determined using a disturbed acreage factor of 0.05 ac-ft. of sediment per acre disturbed.

This factor was determined from the Universal Soil Loss Equation as defined by the Agricultural Research Service (ARS) at Purdue University.* The equation for soil loss A in tons/acre-year is:

$$A = R K L S C P$$

**Wanielista, Martin P., Stormwater Management Quantity and Quality, Ann Arbor Science Publishers, Inc., Ann Arbor, Michigan, pp. 305-318, 1979.*

where "R" is the rainfall erosivity factor, "K" is the soil erodibility factor, "L" and "S" are slope length and gradient factors given as one variable.

$LS = (X/72.6)^m (430\ x^2 + 30x + 0.43)/6.57415$ with "X" being slope length, "m" a function of slope, and "x" the size of the slope angle, "C" is the cover factor, and "P" is the erosion-control practice factor.

Appropriate constants for each factor were obtained for the disturbed area from curves and tables given by the ARS. "R" for the Trail Mountain Mine region of Utah is 25. "K" for the loam to sandy loam soil texture class with > 4% organic matter content is 0.25. For a slope length of 250 feet, and average slope angle of 1.75° (since 17.5° = 0.3), and an "m" of 0.5 for gradients > 5%, "LS" is 13.6. The cover factor "C" is 1.0 for essentially no cover and practice factor is also 1.0 for no control measures presently. With these values "A" is 85 tons/acre-year. This soil type 1.0 ton per 0.95 yd^3 and converting to acre feet gives an annual soil loss factor of 0.050 acre feet per acre disturbed.

Open channel flow capacities were determined using the Manning equation. According to this method:

$$V = \frac{1.486 R^{0.67} S^{0.5}}{n} \qquad (7\text{-}13)$$

where "V" is the velocity in feet per second, "n" is the Manning roughness coefficient, "R" is the hydraulic radius in feet, (defined as the area divided by the wetted perimeter), and "S" is the hydraulic slope, in feet per feet. Estimates of the roughness coefficient were determined from tabular information presented by the US Department of Transportation (1979). The velocity obtained by equation 7-13 was converted to a flow rate using the continuity equation which states that:

$$q = AV \qquad (7\text{-}14)$$

where "q" is the discharge, in cubic feet per second; "A" is the cross-sectional area of flow in square feet; and "V" is velocity in feet per second. A maximum permissible velocity of 5 feet per second for unlined channels was assumed.

Those sections of diversion channels having velocities in excess of 5 feet per second were designed with rock riprap linings in accordance with methodologies presented by the US Department of Transportation (1975). In accordance with this methodology, the maximum permissible depth of flow for a channel lined with rock riprap is determined by:

$$^{d}\max = \frac{63.5(D_{50})}{S_0} \qquad (7\text{-}15)$$

where "^{d}max" is the maximum permissible depth of flow, in feet; "D_{50}" is the mean rock diameter (or the particle size gradation for which 50 percent of the mixture is finer by weight) in feet, 63.5 is the unit weight of water in pounds per cubic feet, and "S_o" is the channel slope, in feet per feet. The mean rock diameter (D_{50}) in each case was assumed from which the maximum permissible depth was determined. The channel configuration was then determined such that the maximum permissible depth at the design flow would not be exceeded.

7.2.3 Existing Surface Water Resources

This section of the report deals with the region in general and the Trail Mountain mine plan area more specifically. Watershed and stream characteristics are both described.

7.2.3.1 Regional Surface Water Hydrology

The Trail Mountain Mine is located immediately adjacent to Cottonwood Creek, one of the major tributaries of the San Rafael River. Near Orangeville Cottonwood Creek has had an annual flow of 70,700 acre-feet during the period of record that extends intermittently from 1909 through the present (US Geological Survey, 1984). Approximately 50 to 70 percent of streamflow in the mountain streams of the region occurs during May through July (Waddell

et al., 1981). Streamflow during this late spring/early summer period is the result of snowmelt runoff.

Snowmelt is the primary source of water for the perennial streams in the San Rafael River Basin with summer precipitation usually producing little runoff (US Geological Survey, 1979). Ephemeral streams are also abundant in the San Rafael River Basin, existing primarily at lower elevations where evapotranspiration significantly exceeds precipitation.

Water use upstream from Castle Valley, the valley containing most of the agricultural land noted in Figure 7-6, is primarily for stockwatering and industrial purposes (coal mining and electrical power generation). Within Castle Valley agriculture and power production utilize nearly all of the inflowing water (Mundorff, 1972), with minimum flows in the gaged streams and rivers in the basin occasionally approaching zero. Storage reservoirs are common at higher elevations throughout the region. Transbasin diversions occur throughout the area.

The quality of water in Cottonwood Creek and other similar streams in the area varies significantly with distance downstream. Waddell et. al. (1981) found that concentrations of dissolved solids varied from 125 to 375 milligrams per liter in major streams in the region in reaches above major diversions to 1600 to 4025 milligrams per liter in reaches below major irrigation diversions and population centers. The major ions at the upper sites were calcium, magnesium, and bicarbonate, whereas sodium and sulfate were more dominant at the lower sites. They attributed the changes to (1) diversion of water containing low dissolved solids concentrations, (2) subsequent irrigation and return drainage from moderate to highly saline soils, (3) groundwater seepage, and (4) inflow of sewage and pollutants from population centers. Average annual sediment yields within the Cottonwood Creek drainage basin range from approximately 0.1 acre-feet per square mile in the headwaters area to about 3.0 acre-feet per square mile near the confluence with the San Rafael River (Waddell et al., 1981).

7.2.3.2 Mine Plan Area Watersheds and Streams, Stream Characteristics, and Watershed Characteristics

A portion of the Cottonwood Creek watershed receives drainage from the mine plan area. Stream channels from the mine plan area flow to the east toward the Cottonwood Canyon Creek and to the south toward Straight Canyon Creek, a tributary of Cottonwood Creek. Cottonwood Creek is a perennial stream.

The Cottonwood Canyon Creek is a major drainage system where evidence of glaciation exists. From the headwaters to Section 24, Township 17 South, Range 6 East, the canyon is characterized by U-shaped valleys with associated lateral and terminal moraine deposits. Lateral moraine deposits most commonly occur at the intersection with side canyons. Terminal moraine deposits occur at the northwest corner of Section 24 and from this point to near the confluence with Straight Canyon the canyon can be characterized as a V-shaped valley with little evidence of glaciation.

Based on data collected by PacifiCorp, Cottonwood Canyon Creek is an ephemeral stream from its headwaters to Section 24, Township 17 South, Range 6 East and intermittent from that point to its confluence with Cottonwood Creek at Straight Canyon. The stream becomes intermittent near the intersection of Roans Canyon just below the terminal moraine deposits discussed above. During drought conditions which have been experienced since 1985, flow in Cottonwood Canyon is limited to flow emanating from the Roans Canyon Spring located in Section 24 near the confluence with Roans Canyon. Prior to the drought, flow occurred along the entire reach of Cottonwood Canyon and had to be forged to access East Mountain at the Mill Canyon dugway located in Section 2.

Along with Roans Canyon Spring, another spring referred to as Cottonwood Spring (TM-23) is also associated with the alluvial (glacial) deposits. Cottonwood Spring is located in the canyon bottom within the area of terminal moraine deposits at an elevation higher than that of Roans Spring. With normal precipitation, especially in the form of winter snowpack, runoff would saturate the alluvial deposits and a portion of groundwater would discharge at the location of Cottonwood Spring. During the period of the drought recharge to the alluvial

deposits has been limited and the level of groundwater has been reduced to a point below the elevation of the Cottonwood Spring. To verify the extent of the alluvial deposits and to define the hydrologic characteristics, PacifiCorp conducted a hydrologic research project in 1992 which included a series of resistivity lines and the drilling of three surface sites (see Deer Creek/Cottonwood/Des-Bee-Dove Permit, Volume 9 - Appendix F for complete details). At each of the surface sites two wells were completed (except for CCCW-2, see Plate 6-2 for well locations), one in the alluvial deposits and one in the Spring Canyon member of the Star Point Sandstone Formation. Wells completed in the alluvial deposits will be utilized to compare the well hydrographs to those of Cottonwood Canyon Creek and the Star Point Sandstone. Monitoring data will be included in future Annual Hydrologic Monitoring Reports.

Surface water-quality data collected from Cottonwood Canyon Creek by PacifiCorp indicate that the dominant ions are: calcium, magnesium, and bicarbonate. Water quality and quantity data collected during the year are presented in the Annual Report. Total dissolved solids concentrations in the stream vary from about 250 to 300 milligrams per liter in the mine area, with the lower concentrations normally occurring during the high-flow season. Slight variations have been noted between stations located upstream and downstream from the permit area (SW-1, SW-2 and SW-3).

As expected, total suspended solids concentrations in Cottonwood Canyon Creek tend to vary inversely with the flow rate. Concentrations have varied during the period of record from less than 1 milligram per liter to greater than 1000 milligrams per liter.

Topography in the area is very rugged, with elevation varying from 6800 to over 9000 feet above sea level. Slopes within the mine plan area vary from near vertical cliffs to less than 4 percent (2 degrees) on Trail Mountain. Major escarpments occur to the east and south of the mine plan area.

7.2.4 Surface Water Development, Control and Diversion

Because of the remoteness and the limited amount of surface water in and adjacent to the mine plan area, essentially no development of the surface water has occurred except from some possible stockwatering. Cottonwood Creek water is used downstream for irrigation and for power generation. This section deals with the surface water supply in the area as well as the specific runoff and sedimentation control measures planned for the Trail Mountain Mine.

7.2.4.1 Water Supply

Surface water in the mine plan and adjacent area is utilized primarily for stockwatering purposes. A listing of surface water rights within the permit and adjacent areas is provided in Table 7-6. (Also see Appendix 7-8 Cottonwood Irrigation Shares.) A review of the files of the Utah Division of Water Rights indicated that additional rights have not been added to the area since that original submittal.

Flow Characteristics - According to Jeppson et al. (1968) the mean annual water yield for the mine plan area is approximately 1.5 inches. Other hydrologic methods (described in Section 7.2.1) were used to determine the mean annual water yield to increase the confidence level of the estimate. According to Grunsky's Rule the mean annual water yield from the mine plan area is 2.0 inches. This was determined using an alpha value of 0.008/in. Water yield studies have found values of 0.007 to 0.009 for un-gaged areas with medium elevations, medium summer rainfall, medium temperature, medium soil, moderate slopes and east exposure. Gaged areas such as Black Mesa and Holbrook Creek, Colorado, and Black Hills, South Dakota, which are similar to the Trail Mountain Mine site, have values ranging from 0.0068 to 0.0090.

According to Ol'deKop's formula (Sellars, 1965), the mean annual water yield from the mine plan area is 2.9 inches. The two methods utilize the information that mean annual precipitation and evapotranspiration over the mine plan area are 16 to 19 inches, respectively (Jeppson et al., 1968).; therefore, estimates of the mean annual water yield from both

Ol'deKop's and Grunsky's formulas compare favorably with the estimate from the Hydrologic Atlas of Utah prepared by Jeppson et al. (1968).

Monthly flows from Cottonwood Canyon Creek were computed as a percentage of annual flow for the water year 1979 (October 1978 to September 1979) to determine the seasonal distribution of flows for streams within and adjacent to the mine plan area. The results are illustrated in Figure 7-7. Although actual monthly percentages will change, the distribution pattern of stream flow is characteristic of watersheds in the western highlands where the majority of annual water yield occurs in the spring and early summer as a result of snowmelt runoff.

Daily discharge measurements for the Cottonwood Canyon Creek were taken only during the three years 1979, 1980 and 1981. Within those years flow varied from 0 to 22 cfs with an average of 1.64 cfs. The average discharges for the respective three years of record were 0.87, 3.33 and 0.72 cfs. The USGS gauging station monitoring was discontinued in September 1981 (additional infomation on flow characteristics of Cottonwood Canyon Creek, review annual Hydrologic Reports).

Surface Water Quality - Three surface water sites (referred to as SW-1, SW-2 and SW-3 in Plate 7-2) have been sampled since 1979. Table 7-3 contains a list of the water quality parameters analyzed along with the results of the chemical analyses of surface water samples collected at these three sites. As illustrated in Plate 7-2, SW-1 is located approximately one mile above the mine, SW-2 is located immediately below all mine surface facilities, and SW-3 is located approximately 2 miles below the mine near the confluence of Cottonwood Canyon Creek and Straight Canyon. Additional water quality data have been collected by the USGS at a gaging station on the Cottonwood Canyon Creek located in the SE1/4NE1/4, Section 36, T17S, R6E. This data is compiled and reported in Table 7-4. This station was discontinued in 1981; however, an additional monitoring station, SW-3, was added by the applicant to monitor Cottonwood Creek below the permit area. Results from all the monitoring stations are summarized in the Annual Report.

As depicted in Tables 7-3 and 7-4 surface waters of the mine plan area are of a mixed chemical type (Calcium-magnesium, bicarbonate) and seasonally vary from a stronger magnesium-bicarbonate to a stronger calcium-bicarbonate. A sample collected by the USGS in November 1978 was a calcium-bicarbonate type whereas those collected in July and September of 1979 were of a stronger magnesium-bicarbonate type.

Total dissolved solids concentrations varied from 226 to 976 milligrams per liter at stations SW-1, SW-2, USGS gaging station, and SW-3. Measurements were taken during all periods of the year, therefore, this range represents both high and low TDS values to be expected during low and high flow periods of the year. From April to June, when stream discharges are highest due to direct snowmelt, a diluting effect usually occurs in surface waters, resulting in a lower total dissolved solids concentrations. Later in the year as flow decreases and the majority of the flow is derived from groundwater, the dilution effect becomes less pronounced and total dissolved solids concentrations increase.

Suspended solids concentrations during the inventory period were found to vary from less than 0.5 milligrams per liter to 5024 milligrams per liter in Cottonwood Canyon Creek. It is known that suspended solids concentrations tend to vary somewhat proportionately with flow rate (Vaughn Hansen Associates, 1979); therefore, during the snowmelt runoff period, suspended solids concentrations are expected to be generally higher than values from low flow periods. The Utah Division of Health has classified Cottonwood Creek within the mine plan area as 1C--protected for domestic purposes with prior treatment by standard complete treatment processes, 3A--protected for cold water species of game fish and other cold water aquatic life, and 4--protected for agricultural uses including irrigation of crops and stockwatering. Table 7-5 contains the numerical water quality standards applicable to the various classifications. Few samples collected by personnel of either Beaver Creek Coal Company or the USGS were noted to exceed the chemical standards. One sample collected at the USGS gaging Station contained a lead concentration of 0.13 milligrams per liter in

excess of the standard set in all three applicable state classifications for the water of Cottonwood Creek.

Water Rights - Surface water rights within and adjacent to the mine plan area have been obtained from the Utah Division of Water Rights and are presented in Table 7-6 and Plate 7-4. In conjunction with the location and permit number, other information included is owner, source of supply, quantity of right, purpose of use, and period of use. As indicated on Table 7-6, the majority of rights in the area are for stockwatering, with only a minor percentage allotted to irrigation.

7.2.4.2 Sedimentation Control Structures and Diversions

One sedimentation pond with corresponding runoff control facilities is constructed to provide sediment control for the Trail Mountain Mine. The layout of the sedimentation control plan, including pond location, pond drainage area boundary, ditches and berms, are illustrated on Plate 7-5.

A sedimentation pond exists on site. Specific design details for the sedimentation pond and channels conveying runoff to the pond are described in this section. All conveyance facilities associated with the runoff control plan have been constructed.

Conveyance Facilities Design - The sedimentation pond is sized to contain runoff from the areas draining onto the mine site. As shown in Plate 7-5, no diversion ditches for undisturbed area runoff are proposed. Only runoff from the side canyon above the operation will be bypassed through a culvert. The side canyon culvert was designed to pass runoff from the 10-year, 24-hour storm (2.4 inches). As stated earlier, Miller et al. (1973) gives values for precipitation. Their Figure 27 indicates a 10-year, 24-hour storm precipitation isopluvial at the mine site of 2.4 inches.

A diversion culvert and curb and gutter system conveys runoff from the disturbed area to the sedimentation pond. The culvert and gutter system were designed to pass runoff from the 10-

year, 24-hour storm [2.4 inches - from Miller et al. (1973), Figure 27 as above]. The diversion culverts for Cottonwood Creek were designed and sized by the U.S. Forest Service and the Division of Oil, Gas and Mining to pass runoff from the 50 year, 24-hour storm [3.2 inches - from Miller et al. (1973), Figure 39, page 41]. The culvert was extended 300 feet upstream in the fall of 1990.

(See Appendix 7-3 for Culvert Specifications.)

(See Appendix 7-13 for Culvert Extension Details.)

Diversion with riprap has a higher roughness coefficient. Peak flows and peak flow design related information for the diversion ditch and culverts are contained in Table 7-7.

The soil conservation service equation for calculation of watershed lag times was used in this analysis:

$$t_L = \frac{(1^{0.8})(S+1)^{0.7}}{1900Y^{0.5}} \quad \text{and} \quad S = \frac{1000}{CN} - 10$$

Where L = the hydraulic length (ft)

Y = the average water shed slope (%)

S = the storage at saturation

CN = curve number

The drainage basin characteristics are given in Table 7-7 along with the resultant:

T_L values: canyon = $(6375)^{0.8}$ $(2.5 + 1)^{0.7}/1900$ $(49.12)^{0.5}$ = 0.2.

Drainage areas for the side canyon 48-inch culvert and Cottonwood Canyon 66-inch culvert are shown on Plate 7-6. Drainage areas for the disturbed and undisturbed drainage to the sediment pond are shown on Plate 7-5. It should be noted that diversion culvert designs for Cottonwood Canyon were originally developed by the U.S. Forest Service and subsequently verified by Vaughn Hansen and Associates as shown in Appendix 7-3. As indicated, the culvert was originally designed with a capacity of 535 cfs, based on the USFS design flood of

450 cfs and the Vaughn Hansen and Associates design flood of 510 cfs. The culvert was extended in 1990, and the design was verified for the 510 cfs flow as shown in Appendix 7-13.

The design flood includes all of the Cottonwood Canyon runoff, down to and including the side drainage and the three culvert inlets from the opposite side of the highway, as shown on Plates 3-1, 7-5 and 7-6.

Design criteria and calculation results for sizes and flows in the diversion system at maximum discharge are presented in Table 7-8. Also contained in Table 7-8 is the required mean rock diameter (D_{50}) for cross sections (with velocities in excess of five feet per second) which would require a rock riprap lining; however, the maximum flow does not result in velocities significantly larger than 5 fps on the non-metal surfaces.

Two other minor inlets to the sediment pond exist at this time. The first inlet is from a small road and pad area at the top of the switchback above the pond. It drains into a vegetated ditch and enters the pond at the point where the dam meets the highwall. The second inlet is from a 24-inch culvert which picks up a small amount of road drainage below the gate. The culvert was installed in 1988 to catch runoff below the gate which may contain dust or mud carried onto the highway by the haul trucks. A third minor inlet was the 4" mine water discharge line. The 4" discharge line located in the 2nd portal south of ROM belt portal was optionally used to channel mine water discharge through the sediment pond in lieu of discharging directly to Cottonwood Creek. Due to increased volume of flow from the shift in mining from the east to west side of the mine, a replacement 8" line now discharges mine water to the 100,000 gallon storage tank. From the storage tank, water can be discharged to an existing 48" culvert as discussed in section 7.2.4.2. pg 3-37. Inflows to the 8" line vary according to routing as well as volume of water to be discharged. The existing 4" line is disconnected within the mine but remains in place on the surface for emergency backup measures and can be easily reconnected if needed. All inlets are shown on Plates 3-1 and 7-5. Design criteria and sizing are shown in Table 7-8.

"BTCA" Areas - It should be noted that two small areas of disturbance do not drain to the pond.

The first "BTCA" area consists of approximately 0.21 acres located just south of the sediment pond. The calculated runoff from this area is 0.013 acre feet, based on the 0.21 acres and a 10-year, 24-hour event. The area is vegetated, and all drainage from the site passes through straw bales, the approved sediment control measure. The realigned stream channel is entirely protected with large (approved size) riprap. Riprap will be maintained at this site until bond release or earlier release by the Division. The straw bales or other sediment control measures, approved by the Division, will be maintained at the site until vegetation is determined adequate by the Division. Adequacy will be based on comparison of the site with the riparian reference area.

The second "BTCA" area consists of approximately .028 acres located above the water treatment plant. The area, which drains to the creek, is an outslope of the pad area and cannot be drained to the sediment pond. The outslope BTCA area is vegetated, and all drainage from the site passes through a silt fence as a final treatment. Silt fences will be maintained at this site until vegetation is deemed adequate by the Division, by comparison with the riparian reference area, or until bond release (see Plate 7-11 for Typical Sediment Control Measures).

Runoff from the area for a 10-year, 24-hour event is calculated to be 0.002 acre feet. The above described "BTCA" areas are shown on Plates 3-1 and 7-5. It should be noted that these areas are included in the total disturbed area for the site (9.85 acres) but are not included in the runoff calculations for disturbed area draining to the pond (9.45 acres) shown on Table 7-9 since they do not drain into the pond.

Sedimentation Pond Design - As mentioned previously, one sedimentation pond is constructed to provide sediment control for the surface facilities of the Trail Mountain Mine. The sedimentation pond was designed to contain sediment storage volume form 0.05 acre-feet of sediment per acre to disturbed area. Sediment will be cleaned out at 60 percent

of the sediment storage level. Sediment yield for the 9.61 acre disturbed area will be 0.47 acre-feet. (Note: 0.16 acres of disturbed area on the new ventilation portal access road drain into the mine, not to the pond).

Spillway capacity requirements for the sedimentation pond were based on runoff from the 25-year, 24-hour storm (2.9 inches). Table 7-9 contains the volume and spillway capacity requirements for the pond as well as additional design related information.

The sediment pond will be inspected quarterly, and a copy of the inspection report will be kept at the mine site. A certified annual inspection report will also be done yearly, with a copy kept at the mine site and one sent to the Division with the Annual Report for the property. The above inspections will be performed in accordance with requirements of R645-301-514.330 and R645-301-514.310, respectively.

The pond design details for the sedimentation pond are illustrated on Plates 7-7 and 7-8 with the stage-capacity curve for the pond given in Figure 7-9. The sedimentation pond consists of a sediment storage pool, a dead pool, and a runoff control pool equal to the inflow volume from a 10-year, 24-hour storm (2.4 inches). A dewatering device is placed in the pond to draw the pond level down to the bottom of the runoff control pool in anticipation of a future runoff event. The Utah Division of Health requires that no dewatering device be placed within three feet of the top of the sediment cleanout level (60 percent); therefore,, a dead storage pool has been created in order to meet the requirements of both agencies. The proposed principal and emergency spillway system consists of a corrugated metal riser and conduit with an anti-vortex device, trash rack, and anti-seep collars. Utilizing Equation 7-16, which defines orifice flow, the discharge capacity of the riser-conduit combination with a diameter of 48 inches was found adequate in passing the peak inflow resulting from the 25-year, 24-hour storm (see Figure 7-10).

Orifice flow occurs when the flow is restricted by the opening and can be determined as;

$$q = CA\,(2gH)^{1/2} \qquad (7\text{-}16)$$

where q is as previously defined; C is a coefficient dependent upon the orifice geometry (0.6 in this case); A is the cross sectional area of the opening, in square feet; g is the gravitational constant (32.2 feet per second squared); and H is the head above the orifice inlet, in feet. The orifices considered are the riser inlet and the inlet of the conduit leading from the riser through the pond embankment.

The total embankment height was obtained by adding the stage at full storage capacity, the head of water over the spillway under design flow conditions, the required freeboard height (1.0 feet), and a five percent settlement allowance. The embankment top width will not be less than (H + 35)/5 where H is the height of the embankment, in feet. Table 7-10 summarizes the design specifications for the sedimentation pond.

The sedimentation pond is constructed between the excavated slope of the old pond and a new embankment constructed over the proposed 66-inch culvert. The excavated slope of the old pond was approximately equal to 1.06H:1V. To obtain the necessary pond storage capacity, the remaining inside slopes of the pond was designed at 2h:1V. The pond is lined with 18 inches of a 10:1 mixture of the embankment material and bentonite, respectively, to prevent seepage and piping.

The dewatering device consists of a 12-inch corrugated metal riser and an 8-inch conduit drainline, antivortex device, trash rack, and anti-seep collars. The anti-vortex also acts as a skimming device by not allowing water to be pulled directly from the surface of the pond. A water control gate valve is located at the end of the 8-inch diameter corrugated metal conduit within the 48-inch spillway within the pond embankment to allow efficient water release.

This was necessitated by the facts that:

1) The water control gate valve must be installed in the manhole/spillway to allow access to the valve;

2) The location of the riser does not allow access to the gate if placed at the extreme inlet;

3) Gates were apparently not available which could be attached between two culverts in a watertight manner; and

4) It was desirable to allow access to the control gate for maintenance purposes.

The control gate operator mechanism is located above the spillway cover. Access to the gate for maintenance can be made via a ladder or rebar rungs which have been welded to the spillway side. A walkway has been installed to allow access to the control gate for purposes of dewatering and inspection. Sufficient space must be available in the pond to completely detain the runoff resulting from the 10-year, 24-hour storm. At the same time, sufficient settling time must be allowed in order to meet applicable effluent standards in the discharged water. It is therefore suggested that water in the pond be released through the dewatering device after 14 days unless there is a good probability of occurrence of a runoff producing storm prior to that time, under which condition the water should be released before the storm occurrence. This would allow sufficient time for all but the fine clay and colloidal particles to settle (U.S. Environmental Protection Agency, 1976).

Anti-seep collars have been used based on methods outlined by the U.S. Environmental Protection Agency (1976). Figure 7-11 outlines details of the proposed anti-seep collars with spacing requirements shown Plate 7-7.

Riprap was placed in the inlet channels and below the outlet conduit of the pond to dissipate energy and reduce erosion potential. Riprap shall also be placed on the inside slope of the pond embankment to a width of five feet on both sides of the spillway and dewatering device up the full height of the embankment to protect the embankment from erosion.

The outlet culvert from the pond discharges onto the riprap protection on the main channel as described in Appendix 7-3.

Sediment Disposal Plans - Federal and State regulations require that sediment, which has accumulated in the pond, be removed when 60 percent of the design sediment storage volume has been filled. The point at which cleanout becomes necessary is 11.2 feet below the top of the riser and can be measured directly with a tape. Sediment removed from the pond will be temporarily stored within the drainage basin to the pond. Removed sediment is disposed of at the Cottonwood Waste Rock Facility.

The procedure for sediment pond cleaning is as follows:

1. Decanting of the pond water:
   a. Discharge through the primary spillway, according to UPDES requirements, and/or;
   b. Pumping the water behind abandoned, sealed mine workings, and/or;
   c. Hauling to the Cottonwood Waste Rock Storage Facility's sediment pond.

2. Sediment disposal at the Cottonwood Waste Rock Facility.

3. Division's "Title V Coal Program Policy for Disposal of Sediment Pond Waste" guideline will be followed for sediment samples and testing.

4. Division will be contacted at the beginning of the sludge transport process.

Pond Reclamation - The disturbed area of the pond has been seeded with the interim (contemporaneous) seed mix. Permanent reclamation of the pond is discussed under Section 7.4.

7.2.5 Effect of Mining on the Surface Water Hydrologic Balance

As has been previously mentioned, the occurrence and quality of water in any region is highly controlled by geology. Section 7.1.3.1 Regional Groundwater Hydrology of this chapter describes in detail the influence geology has on the hydrologic regime. Major drainages conveying runoff away from the permit area are Cottonwood Canyon Creek and Straight Canyon.

With the exception of the very headwater regions of these drainage basins, mining and, therefore, subsidence will not occur beneath the major stream channels of these canyons. In the majority of cases, cracking due to subsidence is not anticipated to extend to the surface; therefore, surface runoff patterns will not be significantly affected. Data collected by PacifiCorp over a ten-year period on the East Mountain permit area concerning subsidence and surface drainages has not detected any surface stream impacts. Consequently, subsidence should not cause significant impacts to the surface water system.

7.2.5.1 Quantity

As mentioned earlier in the report, the major drainage covering runoff away from the mine facility area is Cottonwood Canyon Creek. All surface facilities are located adjacent to Cottonwood Canyon Creek, and surface runoff from disturbed areas is passed through the sedimentation pond prior to discharging in the creek.

Water made within the mine is either; 1) used within the mine and; therefore, retained within the groundwater hydrologic system, or 2) is discharged into Cottonwood Creek. Discharge from the mine will vary depending on localized mining conditions. Underground sumps are installed for storage, settling and recirculation of water. When the sumps become full, water is pumped outside, either to the sediment pond for additional settling or directly to the creek if the quality meets effluent standards. Discharge quantity and quality will be reported in the Annual Hydrologic Reports.

7.2.5.2 Quality

The quality of flow from the headwaters of the San Rafael River Basin is excellent; however, the quality rapidly deteriorates downstream as streams cross shale formations and receive irrigation return flows from Mancos derived soils. The impact of mining on this system will be quite limited.

The existence of runoff and sediment control structures should minimize the potential for degradation of the quality of stream waters due to runoff from disturbed areas of the Trail Mountain Mine.

7.2.6 Mitigation and Control Plans

Runoff from all disturbed areas will be passed through sediment control facilities with the exception of one small "BTCA" area as discussed in Section 7.2.4.2. Any discharge from facilities will be monitored in accordance with UPDES permit standards and State and Federal regulations. The effects of the mining operation on the surface water system will be analyzed through the surface water monitoring plan described in the next section. In the unlikely event that monitoring shows that the surface water system is being adversely affected by mining activities, additional steps will be taken to rectify the situation in consultation with State and Federal regulatory agencies.

7.2.7 Surface Water Monitoring Plan

An ongoing hydrologic monitoring program will be conducted at each of the stations shown in Plate 7-2 and as described in Appendix 7-1. Stations have been established to monitor water quality and quantity above and below the mine plan areas. Monitoring parameters will be in accordance with Table 7-2a in Appendix 7-1. Monitoring schedule and reporting will be in accordance with Appendix 7-1.

7.2.7.1 Baseline Monitoring

All surface water monitoring stations are presently on operational status. Baseline will be conducted every fifth year and compared to historical data.

7.2.7.2 Operational Monitoring

All surface water monitoring stations will be monitored quarterly for flow (when flowing) to delineate seasonal variation and correlate discharge with changes in water quality. The water quality parameters and sampling frequency will be as listed in Appendix 7-1. All surface monitoring stations will be monitored quarterly for water quality. Results of all water quality data will be submitted quarterly and summarized in the Annual Report as described in Appendix 7-1.

7.2.7.3 Postmining Monitoring

Representative surface water stations will be monitored biannually during high and low flow conditions. The representative stations will be determined with the aid and approval of the Utah State Division of Oil, Gas and Mining. Duration of monitoring and parameter selection will be as per DOGM guidelines listed in Appendix 7-1.

7.3 ALLUVIAL VALLEY FLOOR DETERMINATION

Utah regulations (R645-302-320) require that the presence of alluvial valley floors in or adjacent to the mine permit area be identified. The regulations (R645-100-200) define an alluvial valley floor as "unconsolidated stream-laid deposits holding streams with water availability sufficient for subirrigation or flood irrigation agricultural activities but does not include upland areas which are generally overlain by a thin veneer of colluvial deposits composed chiefly of debris from sheet erosion, deposits formed by un-concentrated runoff or slope wash together with talus, or other mass-movement accumulations, and windblown deposits". The existence of an alluvial valley floor is, therefore, determined to exist if:

1) Unconsolidated stream-laid deposits holding streams are present, and

2) There is sufficient water to support agricultural activities as evidenced by:
   a) The existence of flood irrigation in the area in question or its historical use;
   b) The capability of an area to be flood irrigated, based on stream-flow water yield, soils, water quality, topography, and regional practices; or
   c) Subirrigation of the lands in question, derived from the groundwater system of the valley floor.

7.3.1 Scope

The purpose of this document is to examine the potential existence of alluvial valley floors in and adjacent to the areas to be affected by surface operations associated with the Trail Mountain Mine, an underground coal mine located ten miles northwest of Orangeville, Emery County, Utah.

This section is divided into three parts. First, a general description of the surface operations and site disturbances associated with the Trail Mountain Mine is presented. Next, a discussion of geomorphic and irrigability characteristics and the water quality and availability of Cottonwood Canyon drainages as a possible alluvial valley floor is presented. Finally, the conclusions of the alluvial valley floor determination are summarized.

7.3.2 Site Description

Surface facilities associated with the Trail Mountain Mine plan area consist of the portal area located in Cottonwood Canyon and an access road up Cottonwood Canyon.

The climate of the general area is semi-arid and continental. Mean monthly temperatures range from about 8° F to the mid-70's. Temperatures in the region tend to be inversely related to elevation. Average annual precipitation is approximately 16 inches. Seventy percent of the annual precipitation falls during the winter as snow with most of the remainder coming as summer thunderstorms.

7.3.3 Alluvial Valley Floor Characteristics

The various criteria for determining the existence of an alluvial valley floor are examined in relation to the Trail Mountain Mine plan and adjacent areas.

7.3.3.1 Geomorphic Criteria

Alluvial deposits in and adjacent to the mine permit area are shown on Plate 7-9. Plate 7-9 shows the extent of the alluvium as presented by Doelling (1972) and shows that the alluvium is found primarily along Lower Cottonwood Creek and at the mouth of the Cottonwood Canyon Creek. Only very narrow bands of alluvium are found along the Cottonwood Canyon Creek above the canyon mouths.

7.3.3.2 Water Quality and Availability

The potential for flood and subirrigation are now evaluated in conjunction with the alluvial valley floor determination.

Flood Irrigation - Flood irrigation near the mine plan area is currently, and has historically been, confined to the alluvial areas of Lower Cottonwood Creek. Water is diverted at the mouth of the Cottonwood Canyon Creek to irrigate fields on the alluvium.

No flood irrigation has historically been practiced on the narrow alluvium land upstream in the canyon opening to Lower Cottonwood Creek. A reconnaissance survey of the surrounding region indicates that flood irrigation is also absent in other areas of similar hydrologic, geologic, and biotic characteristics. The historic lack of flood irrigation in these steep, narrow canyons suggests that such activities are not feasible in the region. In addition, the topography is very steep and consequently not conducive to agricultural activities.

Cottonwood Canyon Creek water quality is good. A detailed review of the surface water quality has been presented previously in this report.

Subirrigation - Some subirrigation of vegetation does occur on the alluvial valley floors shown in Plate 7-9. The subirrigated species, mainly cottonwoods and willows, are found along the channels of Cottonwood Creek suggesting that subirrigation is confined to the channel areas where the water table is near the surface.

7.3.4 Alluvial Valley Floor Identification

Based on the foregoing reconnaissance analysis, the canyon of Cottonwood Canyon Creek cannot be considered an alluvial valley floor due to the lack of area for supporting an agriculturally useful crop. The valley floor of Lower Cottonwood Creek, however, can be classified as an alluvial valley floor due to the presence of both flood irrigation and limited subirrigation on the alluvium. The flood or subirrigated alluvial areas are located over two miles from the mine permit area and are used for pasture and hay production.

7.3.5 Potential Impacts to the Alluvial Valley Floors

Plate 7-9 shows that the Trail Mountain Mine plan area is over two miles from the alluvial valley floor at Cottonwood Creek. Little potential exists for the mine operation to impact the alluvial

valley floor. Access to the mine is by existing county road across a minimal amount of alluvial area. All surface disturbances in the portal area will be protected by sediment control facilities and will be designed and constructed according to the Utah Coal Regulations in an environmentally sound manner.

The hydrologic monitoring program will help determine the actual impact of surface activities and aid in selecting mitigating measures, if necessary. However, it is PacifiCorp's position that the Trail Mountain Mine and associated activities will have no significant hydrologic impacts to the alluvial valley. Details concerning this monitoring program are outlined in a previous section of this report.

7.4 CLIMATOLOGICAL INFORMATION

PacifiCorp operates a network of weather stations, including two at low elevations (Hunter and Huntington power plants) and two at high elevations (Electric Lake and East Mountain).

7.4.1 Precipitation

The climate of the permit area has been described by the U.S. Geological Survey, which states that it is semi-arid to subhumid and precipitation generally increases with altitude. The average annual precipitation ranges from about ten (10) inches in the lowest parts of the permit area (southeast) to more than twenty-five (25) inches in the highest parts (northwest). PacifiCorp's weather station, located in Section 26, Township 17 South, Range 7 East, has provided data which shows that the summer precipitation in the form of thundershowers averages about the same as the winter precipitation in the form of snowfall. Because much of the summer precipitation runs off without infiltration, the winter precipitation has the greatest impact on groundwater.

Precipitation amounts have been and will continue to be recorded at the Hunter and Huntington power plants, at Electric Lake Dam, and on East Mountain. Precipitation data can be found in the annual Hydrologic Monitoring Report (Table 7-12 for East Mountain data).

7.4.2 Temperatures

Air temperatures vary considerably both diurnally and annually throughout the permit area Midsummer daytime temperatures in lower areas commonly exceed 100° F, and midwinter nighttime temperatures throughout the area commonly are well below 0° F. The summer temperatures are accompanied by large evaporation rates. Although not recorded, there probably also is significant sublimation of the winter snowpack, particularly in the higher plateaus which are unprotected from dry winds common to the region. Temperature information is collected at the UP&L weather stations at each power plant, at Electric Lake, and on East Mountain. These data will continue to be included in the annual Hydrologic Monitoring Report (see Table 7-12 for East Mountain data).

7.4.3 Winds

The winds in the area are generally variable. The wind rose presented in Figure 7-13 displays the variability for the Meetinghouse Ridge area for January to December 1978.

7.5 RECLAMATION HYDROLOGY

7.5.1 General

Reclamation hydrology will take place in two phases. Phase I reclamation will consist of removal of all diversions and the majority of the culverts, restoration of the main and side canyon channels, and redirection of the reclaimed area runoff to the sediment pond. Phase II reclamation will consist of the removal of the sediment pond and all remaining culverts after revegetation standards have been reached.

It is proposed to use a 2-Phase reclamation program with a sediment pond remaining through Phase I because of the close proximity of the site to an intermittent stream and the resulting difficulty in controlling both runoff and sediment by other means. Another advantage to this approach is that by leaving some culverts in place, access is provided for required maintenance by equipment.

The following sections will describe each of the major hydrologic items involved in reclamation, along with details on design, operation and final disposition.

7.5.2 Cottonwood Canyon Channel

During Phase I of the reclamation, the 66-inch culvert that presently carries the main canyon drainage beneath the site will be removed. The 96-inch to 66-inch transition and trash rack will be relocated to a point just above the sediment pond, as shown on Plate 3-12. The stream channel will be reconstructed through the property, down to the new culvert inlet near the pond.

It is expected that the reconstructed channel will be on bedrock and, or that reason, it was proposed that only the channel sides be protected by riprap. Since the bottom conditions are unknown, PacifiCorp will commit to placement of appropriately sized riprap and filter blanket on the channel side and bottom, unless the bottom turns out to be on bedrock.

Riprap, filter blanket and flow designs and calculations are detailed in Appendices 7-3 and 7-4. Design criteria are summarized in Table 7-11 in this Chapter. See Plate 3-12 for structure locations. The reclaimed main channel slope is projected to be a consistent 6% as shown in Table 7-11 and on Plates 3-12 and 3-12A.

The reclaimed area runoff will be prevented from reaching the restored channel by installation of an earthen berm on the reclamation side of the channel. The berm will direct disturbed runoff to the sediment pond. A typical section of the restored channel (and berm) is shown on Figure 7-12.

When the revegetation standards have been met, the second phase of reclamation will begin. It will consist of removal of the sediment pond and all remaining culvert sections. The remaining channel area will be restored as in Phase I, and all newly disturbed areas will be reseeded. Additional sediment and/or erosion controls, such as strawbales, silt fence, berms, etc., will be installed if necessary to protect the restored channel and stream.

During reconstruction of the main channel, it is proposed to divert the Cottonwood Creek flow around the minesite. This will be accomplished by installation of a small, temporary dam in the channel with a pump diverting the flow into a flexible culvert (or other conveyance structure), which will discharge either back into the culvert below or into the channel below the pond.

7.5.3 Side Canyon Channel

During Phase I of the reclamation, the 48-inch culvert will be removed from the side channel down to its confluence with the restored main channel. The side channel will also be restored and riprapped as described in Appendix 7-3. At the intersection of the side and main channels, 40 feet of 48-inch culvert will be left in place in the side channel. The inlet section and trash rack will also be installed at this location. The reclaimed area will be separated from the restored channels by installation of an earthen berm on the reclamation side of the channels, providing for reclaimed area drainage to the north of the side canyon to flow over the culverted area and to the sediment pond.

During Phase II, the remaining 48-inch culvert will be removed along with the sediment pond and remaining main channel culverts when revegetation standards have been met. The remaining disturbed area will then be reseeded in accordance with the plan.

Design parameters are summarized in Table 7-11 of this Chapter. Riprap, filter blanket and flow designs and calculations are detailed in Appendices 7-3 and 7-4. A typical section of the restored side channel is shown in Figure 7-12, and the overall plan and structure locations are shown on Plates 3-5 and 3-6.

7.5.4 Sediment Pond

The sediment pond will remain in place during Phase I of reclamation. There will be no change in pond size, operation or configuration. The reclaimed area runoff will be directed to the pond at the existing inlet location by earthen berms as described in the previous sections. Runoff area will be less than the operational design area by the amount of area involved in the channel restoration; therefore, the pond capacity is more than adequate to contain the reclaimed area runoff from a 10-year, 24 hour event.

The sediment pond will continue to be operated, maintained and inspected, as required, until such time as it can be removed.

When revegetation standards have been reached on the reclamation, the sediment pond and all remaining culverts will be removed. Any sediment removed from the pond will be hauled to the Cottonwood Waste Rock Facility for disposal. The main channel will be restored through the former pond area, and all remaining disturbed areas will be reseeded.

Pond design details can be found in Section 7.2.4.2 of this Chapter. Structure locations for Phases I and II of reclamation are shown in Plates 3-5 and 3-6.

7.4.5 Post-Mining Water Monitoring

Upon completion of Phase I of the reclamation, all water monitoring locations with the exception of the UPDES sampling point for the sediment pond discharge will enter reclamation status. Post-mining monitoring will take place at the locations and frequencies described in Appendix 7-1. The UPDES (pond discharge) point will continue to be monitored in accordance with requirements of the permit until such time as the permit is cancelled and/or the pond is removed.

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