

| Talisman Energy USA Inc. Shale Wells Water Analysis Tracking | | |
|---|------------------------|-------------------|
| Constituent | Units | UCL (95%) |
| Acidity as CaCO ₃ | mg/L CaCO ₃ | 207.277 |
| Alkalinity as CaCO ₃ | mg/L CaCO ₃ | 253.911 |
| Bromide | mg/L | 901.930 |
| Chloride | mg/L | 105338.661 |
| Hardness as CaCO ₃ | mg/L CaCO ₃ | 48092.186 |
| Ammonia Nitrogen | mg/L | 89.939 |
| Total Kjeldahl Nitrogen | mg/L | 169.483 |
| Nitrate-Nitrite as N | mg/L | 0.305 |
| Oil & Grease | mg/L | 46.771 |
| BOD 5 Day | mg/L | 1106.739 |
| Chemical Oxygen Demand | mg/L | 67382.920 |
| PH | STD Units | 6.395 |
| Phenolics | mg/L | 0.193 |
| TDS @ 180 C | mg/L | 193105.999 |
| Total Suspended Solids | mg/L | 1822.447 |
| Specific Conductance | UMHOS/CM | 176368.905 |
| Sulfate | mg/L | 50.000 |
| Surfactants MBAS | mg/L | 29.186 |
| Aluminum, Total | mg/L | 13.018 |
| Arsenic, Total | mg/L | 0.047 |
| Barium, Total | mg/L | 9082.730 |
| Beryllium, Total | mg/L | 0.001 |
| Boron, Total | mg/L | 0.921 |
| Cadmium, Total | mg/L | 0.004 |
| Calcium, Total | mg/L | 12632.703 |
| Chromium, Total | mg/L | 0.050 |
| Cobalt, Total | mg/L | 1.588 |
| Copper, Total | mg/L | 0.324 |
| Iron, Total | mg/L | 185.031 |
| Iron, Dissolved | mg/L | 186.278 |
| Lead, Total | mg/L | 0.051 |
| Lithium, Total | mg/L | 633.925 |
| Magnesium, Total | mg/L | 1185.032 |
| Manganese, Total | mg/L | 3.485 |
| Mercury, Total | mg/L | 0.000426 |
| Molybdenum, Total | mg/L | 0.576 |
| Nickel, Total | mg/L | 0.112 |
| Selenium, Total | mg/L | 0.052 |
| Silver, Total | mg/L | 0.016 |
| Sodium, Total | mg/L | 39080.870 |
| Strontium, Total | mg/L | 3715.607 |
| Zinc, Total | mg/L | 0.665 |
| Benzene | ug/L | 2.500 |
| Toluene | ug/L | 2.500 |
| Gross Alpha | pCi/L | 458.565 |
| Gross Beta | pCi/L | 216740.951 |
| Radium-226 | pCi/L | 242.283 |
| Radium-228 | pCi/L | 91.182 |

Notes:

1. mg/L = milligrams per liter
 2. µg/L = micrograms per liter
 3. pCi/L = picocuries per liter
 4. umhos/cm = micromhos per centimeter
 5. **BOLD VALUES** indicate log normal UCL.
- calculations were modified for data sets that were not normally distributed, based on Lilliefors Test for Normality.

UCL

SECTION B – 2b

Waste Sampling Method – Brine and Wastewater

Wastewater samples are collected from the access hatch in the top of the closed tanks. This is accomplished by repeatedly filling a bailer with sample. The sample is then decanted into prepared sample bottles, creating the appropriate sample aliquots for specific analyses. One bailer full is used to collect a sample for volatile aromatics. The sample is measured for temperature and pH in the field using a calibrated pH meter and temperature sensor.

QUALITY ASSURANCE MANUAL

SEEWALD LABORATORIES, INC.

1403 WEST FOURTH STREET

WILLIAMSPORT, PENNSYLVANIA 17701

570-326-4001

Approved By (Owner):



Date:

1-11-10

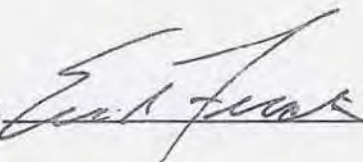
Approved By (Laboratory Director):



Date:

1/11/10


Approved By (Microbiology Director):



Date:

1/11/10

Approved By (Quality Assurance Director):



Date:

1/11/10

Preface 1:

Preparations & Revisions History

Effective Date: June 3, 1998

Revision 1: February 1, 2002

Revision 2: January 06, 2003

Revision 3: March 11, 2004

Revision 4: March 22, 2004

Revision 5: June 10, 2005

Revision 6: April 28, 2006

Revision 7: September 22, 2008

- Revisions include Section 18: Appendices, including Appendix A - Distribution list; Appendix B – List of Employee signatures/initials; Appendix C – revision History

Revision 8: October 17, 2008

- Revisions include Section 2.1 – another point added under Laboratory Director responsibilities to state his/her authorization to approve and release analytical reports; same point added under Technical Director responsibilities (currently Lab. Director); Manager of Quality Assurance revised from "currently Laboratory Director" to "currently Quality Assurance Officer;" another point added under Manager, Microbiology to state his/her authorization to approve and release analytical reports. Added Section 8.7 Ownership Transfer Responsibilities.

Revision 9: January 11, 2010

- Revisions include every section combined into one document with one revision number. Each section updated to reflect current Laboratory practices and to meet Chapter 252 requirements.

Prepared By (Christopher M. Fuller):



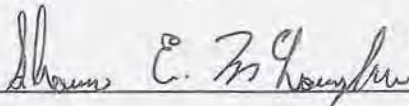
Date: 1/11/10

Reviewed By (Jessica Gehr):



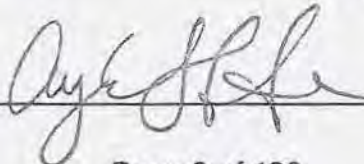
Date: 11 Jan 10

Reviewed By (Shawn McLaughlin):



Date: 01/11/10

Reviewed By (Angela Shaffer):



Date: 01/11/10

Preface 2:

2.1 Distribution List:

There are two master Quality Assurance Manuals (QAM) located in the Laboratory (Lab), one is stored in electronic format under the Quality Assurance/Quality Control Director's (QA/QC) secure network folder, and the other is located in the secure Quality Control (QC) cabinet. The only document that contains all the appropriate signatures is the one in the QC cabinet. The following is a list of locations/departments where the QAM is located through out the Lab for easy reference. These locations have a copy of the master document stamped "COPY" in blue. These documents are all controlled by the QA/QC Director and the Laboratory Director.

- Office/Packing Room – 1 copy
- Wet Chemistry – 1 copy
- Metals – 1 copy
- Organics – 1 copy
- Microbiology – 1 copy

The following is a list of all copies made that are not listed above.

1. 1 copy 1/12/10 sent to PA DEP - Amy Henderson
2. _____

3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____

TABLE OF CONTENTS

OVERVIEW

SECTION 1

1.1 Purpose

1.2 Objectives

1.3 Major Components of the QA Process

STAFF ORGANIZATION AND RESPONSIBILITIES

SECTION 2

2.1 Laboratory Director

2.2 Microbiology Director

2.3 Technical Director

2.4 Quality Assurance/Quality Control Director

2.5 Sample Control Manager

2.6 Client Services Manager

2.7 Organics Department Manager

2.8 Metals Department Manager

2.9 Wet Chemistry Department Manager

HEALTH AND SAFETY POLICY

SECTION 3

3.1 Fume Hoods

QUALITY CONTROL

SECTION 4

4.1 Notebooks

4.2 Automated Data acquisition

- 4.3 Standard Preparation
- 4.4 Quality Control and Blind Samples
- 4.5 Analytical Balances
- 4.6 Thermometers
- 4.7 Spectrophotometers
- 4.8 Temperature Controlled Devices
- 4.9 Laboratory Water System
- 4.10 Control Charting
- 4.11 pH Meters
- 4.12 Conductivity Meters
- 4.13 Dispensing Devices

TRAINING AND STANDARDIZATION

SECTION 5

- 5.1 Documentation of Training File
- 5.2 Work Cells

QUALITY ASSURANCE AUDITS

SECTION 6

- 6.1 Introduction
- 6.2 Purpose
- 6.3 Quality Assurance Auditors
- 6.4 Post Audit Debriefing

STANDARD OPERATING PROCEDURES

SECTION 7

7.1 Purpose

7.2 SOP Contents

7.3 SOP Generation

7.4 SOP Necessity

7.5 SOP Modification

DOCUMENT CONTROL & RECORDKEEPING

SECTION 8

8.1 Introduction

8.2 Standard Operating Procedures

8.3 Computer Generated Data and Instrument Printouts

8.4 Data Packages

8.5 Client Reports/Invoices

8.6 Ownership Transfer and Ownership Termination Responsibilities

8.7 Record Keeping

SAMPLE HANDLING

SECTION 9

9.1 Sample Acceptance and Custody

9.2 Sampling

9.3 Laboratory Sample Control and Sample Tracking

9.4 Sample Storage and Sample Check Out

USING QUALITY CONTROL IN THE LABORATORY

SECTION 10

10.1 The Purpose of Quality Control

10.2 Definitions

10.3 Applying Quality Control

DATA QUALITY CALCULATIONS

SECTION 11

11.1 Significant Figures

11.2 Rounding

11.3 Precision

11.4 Accuracy

DATA REDUCTION & REPORTING

SECTION 12

12.1 Precision and Accuracy Reporting

12.2 Method Detection Limits

12.3 Maximum Concatenation Levels

EQUIPMENT LISTING & PREVENTIVE MAINTENANCE

SECTION 13

13.1 Major Equipment Listings

13.2 Preventative Maintenance

13.3 Maintenance Responsibilities

13.4 Maintenance Schedules

13.5 Spare Parts

CORRECTIVE ACTION

SECTION 14

14.1 QA/QC Corrective Actions

14.2 Failed QC Criteria

| | |
|--|-------------------|
| SOP REFERENCES LISTING | SECTION 15 |
| LABORATORY ETHICS POLICY | SECTION 16 |
| 16.1 Code of Conduct | |
| 16.2 Examples of Improper Laboratory Practices | |
| 16.3 Personnel Education and Training | |
| 16.4 Violations | |
| PREVENTING IMPROPER & UNETHICAL ACTIONS | SECTION 17 |
| 17.1 Ethics Policy | |
| 17.2 Internal QC/PT studies | |
| 17.3 Data Review | |
| 17.4 External Audits | |
| 17.5 Correction Action Plan | |
| 17.6 Document Control | |
| REFERENCES | SECTION 18 |
| PERSONNEL FILES | SECTION 19 |
| 19.1 Personnel Records | |
| 19.2 Dates of Employment and Laboratory Responsibilities | |
| 19.3 QAM Signatures | |
| 19.4 Ethics Training Signatures | |

SECTION B – 2d

Hazardous Waste Determination

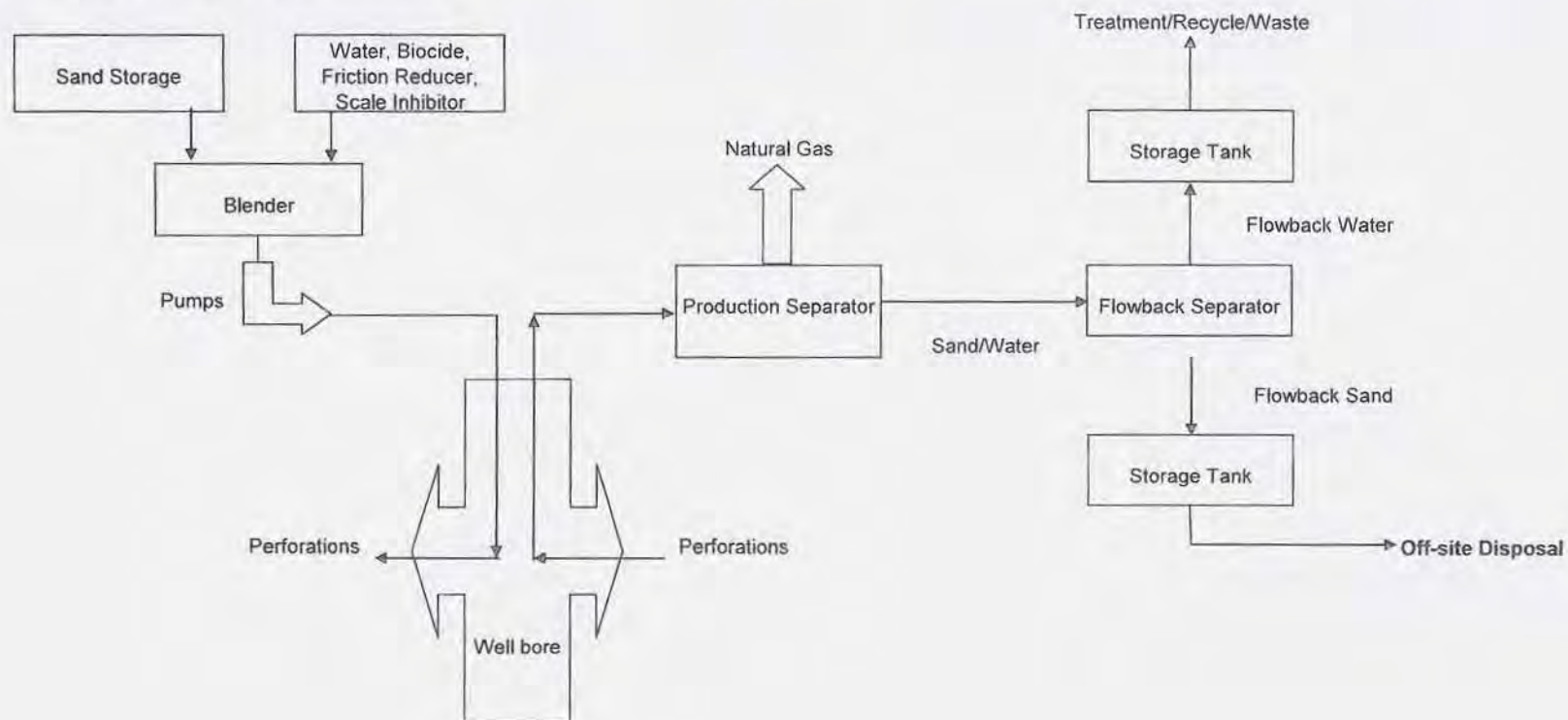
In accordance with Federal Code 40 CFR 261.4 (b)(5) and as incorporated by reference at 25 PA Code 261A.1 drilling fluids, produced waters, and other wastes associated with the exploration, development, or production of crude oil, natural gas or geothermal energy are exempt from being classified as hazardous waste.

SECTION B - 3a and 3b

Process Description for Generation of Flowback Water

Flowback water is generated during the completion/hydraulic fracturing of a natural gas well. Sand and water is injected into the well bore to fracture the shale and hold open the fractures. The water is returned to the surface and either treated, recycled, or wasted.

Schematic of Flowback Water Generation

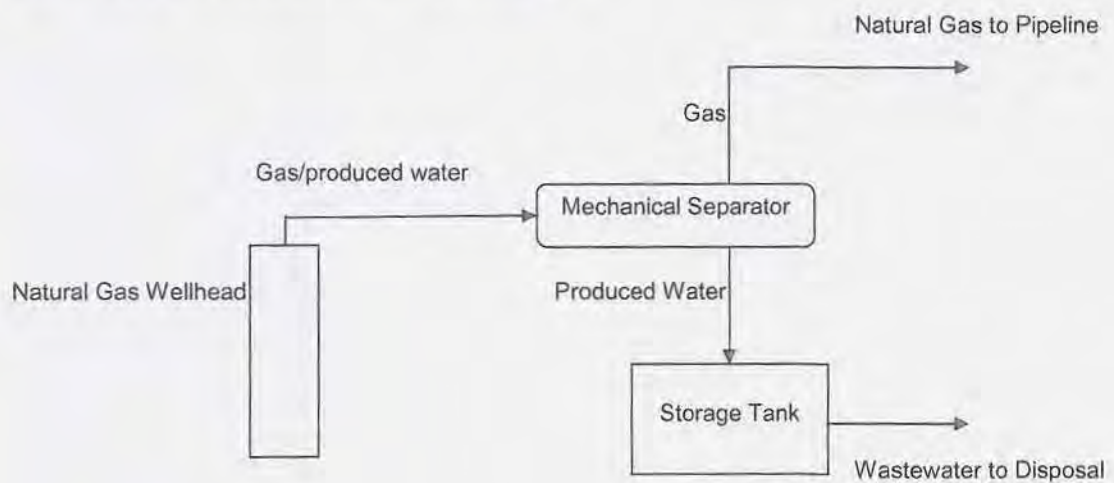


SECTION B - 3a and 3b

Process Description for Generation of Produced Water

A natural gas well produces a combination of gas and produced water. The gas and water come out of the ground at the well head and flow through a short flowline to a mechanical separator. The mechanical separator separates the two fluid streams, allowing the gas to flow out the top into a pipeline while collecting the produced water in a storage tank. The produced water is then trucked to disposal.

Schematic of Produced Water Generation



2.e. Explanation Supporting Use of Generator Knowledge

The oily water waste generated at the natural gas compressor stations is of a known and constant quality. It is an oil/water emulsion and is specially handled by a separate waste transport company for solidification and/or recycling.

3.a. Process Description for Generation of Oily Water Waste at Natural Gas Compressor Stations

Compression of natural gas is required periodically along the collection pipelines to ensure that the gas remains pressurized. Compression occurs at a compressor station. Within the compressor station, scrubbers and dehydration towers capture any liquids or other unwanted particles from the natural gas in the pipeline. Although natural gas in pipelines is considered 'dry' gas, it is not uncommon for a certain amount of water and hydrocarbons to condense out of the gas stream while in transit.

3.b. Schematic for Generation of Oily Water Waste at Natural Gas Compressor Stations

