行政院及所屬各機關出國報告

（出國類別：考察）

參訪美國馬里蘭環保局及科羅拉多淨水場報告

服務機關：經濟部台灣自來水公司
姓名職稱：楊昭端工程師
派赴國家：美國
出國期間：100 年 10 月 22 日至 100 年 10 月 28 日
報告日期：100 年 12 月 2 日

摘 要

飲用水水質安全一直是世界各國政府與民眾所關心的問題，同時亦已逐漸成爲我國重要的公共議題之一。飲用水與民眾健康息息相關，世界各先進國家均將提供品質優良的飲用水，視爲維護大眾健康重要工作。

美國環保署訂定各項飲用水水質標準，授權州政府執行，環保局依據法規標準保護、管控水源，並輔導自來水業者供應合格飲用水。對於飲用水水質標準之罰則亦分級（primary；secondary）訂定。提倡自來水業者自主管理水質，發給操作；處理；檢驗等證照，由業者定期申報水質之信任管理，以違者重罰方式，不擔心業者造假，業者亦有相同理念，以良心事業爲己任，不作假不隱匿，此守法精神乃先進國家的表徵。

此行參觀兩個不同型態淨水場，一個傳統式，另一個相當我國高級處理廠，處理單元與我國相差不多，但環境乾淨設備整齊劃一，操作機房、辦公室、實驗室窗明几淨一塵不染，讓參觀的消費者非常放心他們喝的水，信心指數自然高。

關鍵字：水質檢測、自來水

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隨著時代進步，被發現之污染有害物質日增，水質標準亦日益嚴苛，環保署 97 年於飲用水水質標準中增訂戴奧辛檢項及限值，98 年於飲用水淨水處理藥劑次氯酸鈉中增訂溴酸鹽檢項及限值，99 年於飲用水水質標準中增加溴酸鹽檢項及限值，自來水事業面臨新增挑戰，須不斷提昇水質管理、水質檢測及水質處理相關知識與處理技術，極有需要派員前往先進國家瞭解與取經，以供本公司精進參考，本案因美國環保署已對戴奧辛及溴酸鹽已有規定，故派人前往美國，參訪及研習探討專業管理、檢測技術及蒐集此方面之相關規定及做法。

貳、行程

參訪期間爲自 100 年 10 月 22 日至 100 年 10 月 28 日共計 7 日（含例假日）。研習行程如表 1 所示。

表 1 研習行程

日期	工作記要
10 月 22 日（六）	台北出發 至 美國洛杉磯（22 小時），時差關係到達日仍爲 10 月 22 日，住宿（洛杉磯）休息
10 月 23 日（日）	直接搭乘國內線飛往科羅拉多（5 小時），住宿（丹佛）休息
10 月 24 日（一）	前往 HACH 公司研習，拜訪環保署官員
10 月 25 日（二）	參訪當地淨水場，住宿（丹佛）
10 月 26 日（三）	飛往巴爾的摩（6 小時），住宿（巴爾的摩）
10 月 27 日（四）	拜訪馬里蘭州 EPA，住宿（巴爾的摩）
10 月 28 日（五）	拜訪當地淨水場，住宿（巴爾的摩）
10 月 29 日（六）	飛回洛杉磯（8 小時），住宿（洛杉磯）返回台灣，到達日爲 10 月 31 日

參、參訪過程

科羅拉多州背景簡述：

科羅拉多州（英語：Colorado）是美國中西部的一州，此州最著名的是擁有洛磯山脈的最高峰，地形從東側的平原陡然升高爲西側峻嶺，地理景觀十分壯麗。該州首府兼最大城爲丹佛。在整個丹佛的都會區中就包含了該州半數以上的人口總數（約 250 萬人，全州共有約 505 萬人）。科羅拉多州是以西班牙語「Colorado」命名的，意爲「帶點紅色的」，估計這可能指的是該地區紅色的砂岩地層或是科羅拉多河兩岸的赭紅色景觀。

2008 年美國「科羅拉多州」小鎮「阿拉莫薩」的自來水遭到沙門氏桿菌污染，造成 57 人不適，另外還有一百多人疑似染病。科州公共衛生官員表示，實驗室的化驗證實阿拉摩沙市的供水系統遭到感染。呼籲民眾停止飲用自來水，或用來刷牙及洗滌。當地居民每天都可以獲得一加侖的瓶裝水飲用，科羅拉多州長瑞特宣布「阿拉莫薩」進入緊急狀態，用氯溶劑清洗全市的供水系統，持續數日，直到自來水潔淨爲止。

今年日本核災，美國科羅拉多州也偵測微量輻射碘 131，該州衛生署從丹佛（Denver）偵測器的初步採樣，測到送交美國環境保護署（EPA）進一步檢驗，偵測到的量非常少，對人體健康無害。

一、HACH 公司 研習

接待人：Cary B. Jackson Ph.D.（Director of Regulatory Affairs）

電話：970-669-3050

地址：5600 Lindbergh Drive Loveland, Colorado 80539

HACH 公司成立於 1947 年，總部位於美國科羅拉多州的 Loveland 市，是全球領先的水質分析解決方案的提供商。1999 年，Hach 公司加入美國 Danaher(丹納赫)集團，現在是 Danaher 集團下屬的一級子公司。Danaher 集團是一家在美國紐約交易所上市的公司，旗下主要有 6 大戰略平臺，分別是環境、手工工具、運動控制、醫療、產品標識和電子測試，2008 年全球銷售額超過 120 億美元。哈希公司作爲全球首位的水質分析儀器儀錶供應商，現已成爲 Danaher 集團下最強有力的支柱品牌。

HACH 公司旗下擁有許多知名的專業品牌，包括 GLI、American Sigma、Hydrolab、OTT、Radiometer、Lachat、Polymetron、Orbisphere、ELE 等，工廠分別位於美國、德國、瑞士、法國和英國，並也在中國建立了生產基地。

HACH 的全系列產品包括實驗室分析儀、可攜式分析儀以及線上分析儀、水質自動採樣器、流量計等，致力於爲純水/超純水、飲用水、市政污水、工業廢水、環境監測以及高校科研等各個領域的用戶提供最優的水質監測解決方案。該公司非常注重技術革新，致力於爲用戶提供高精度的儀器和專家級的服務，目前公司在美洲、歐洲和亞洲都有強大的研發團隊。獲得的專利多達 527 項，覆蓋了 130 多個專利家族，同時還擁有超過 100 種的測試方法被美國 EPA 所認可。LDO 螢光法溶解

氧測定技術是水質分析領域內的一項重大突破。Guardian Blue 管網水質監測系統也曾經獲得 R&D 雜誌評選的 100 個最重要的技術研發新產品之一的大獎。

該日的研習內容如下：

Preliminary Agenda – Ms. Yang, Taiwan Water Company

08.30am-09.00am	Welcome to Hach and introduction	T.Voll/A.Mau
09.00am-09.30am	Company Introduction and LSBU	T.Voll/A. Mau
09.30am-10.30am	Company Tour	T.Sundby/J.Way
10.30am-11.30pm	EPA Trends – Discussion EPA consultant	C.Jackson
11.30pm-14.00pm	Lunch	
14.00pm-15.30pm	Acute toxicity testing(ECLOX, SA1100 and WDMP)	Lynn Egan/ Scott Tucker/ Katy Craig/Dan Kroll
15.30pm-16.30pm	Echem Product Portfolio – presentation	Faye Bonomo/A. Mau

因 HACH 水質檢測儀器方法必須取得 USEPA 認可(aproove)，故委任專人（**Cary B.Jackson Ph.D.**）處理 USEPA 事務，對 EPA 法規非常清楚。

以下對談：

1. 美國有沒有飲用水的水源是否訂定水質標準，台灣的飲用水水源必須符合飲用水水源水質標準水公司方得取用最爲原水，美國的環保署是否訂定類似的規則

   Ans：美國有針對水源訂定標準，但是不是 FOR 飲用水，而是 FOR 環境。美國環

保署訂定待列管污染物清單考量下列因素：

- 污染物之潛在毒性效應
- 潛在暴露評估（產生量及暴露機會）
- 分析檢測方法是否經濟可行
- 是否有環境水體及淨水處理單元之檢測數據
- 淨水程序之處理效能

2. 剛剛說美國 EPA 在訂定依個水質標準是非常慎重的，且必須是容易檢測，方法不貴的，並不全然，現今戴奧辛的檢測就很昂貴。

Ans：戴奧辛的檢測方法固然昂貴，但美國環保署另採用一種較便宜的方法快篩後，有問題的樣品再使用標準方法確認其成分，這方法已在網站上公告多年。(附錄一；後來作者在網站上看到環檢所也已取得該方法的認證)，可以減少許多時間與金錢。

3. 自來水廠使用淨水用藥之品質（如此氯酸鈉之溴酸鹽成分）是否有規定

Ans：美國使用次氯酸鈉處理消毒者，採源頭管理方式，用藥品質須符合ANSI/NSF Standard 60 或AWWA Standard for Hypochlorites（B300-04）之規定其中對溴酸鹽含量規定亦在其中。經NSF 認証核可之淨水用次氯酸鈉包括（一）低溴酸鹽含量次氯酸鈉液（二）一般等級溴酸鹽含量次氯酸鈉液兩種等級，淨水用藥之品質於AWWA出版之STANDARDS中有詳細的建議（附錄三AWWA STANDARDS目錄），但因文件需付費取得，未便提供。

4. 美國的淨水場是否參加 ISO 認證(ISO 9000 or 14000)

Ans：美國淨水場不參加 ISO 認證，但 EPA 要求自來水場必參予下列認證：

操作員認證

水場操作員必須通過建立公共供水系統的運作和維護最起碼的專業標準。1999 年，EPA 發布了運營商的認證計劃的指導方針，爲公共供水系統的運營商的認證和換發新證訂定最低標準。雖然各州的具體要求不盡相同，所有運營商的認證計劃的目標是確保由技術熟練的專業人員負責安全飲用水的處理和調配。 操作員認證是遵守促進安全飲用水法案（SDWA）重要一步。

檢驗室認證

公共供水系統必須證明其水質符合衛生，爲基本的要求，而實驗室分析飲用水樣品必須經環保局或國家監管。分析水樣以滿足聯邦的監測要求，或證明符合飲用水法規時，必須使用環保局審查和批准可以使用的方法。這些實驗室分析樣品，必須由環保局或國家認證，認證的實驗室必須通過盲樣測試樣品，定期更新核准之檢驗方法，並通過定期的現場評鑑。

圖 1.在 HACH 公司聆聽公司簡介及產品說明

圖 2.參訪人員與 HACH 公司人員合影

二、 **造訪** Soldier Canyon Filter Plant

接待人：Chris Harris（Assistant Manager）

電話：970-482-3143

地址：4424 Laporte Ave.Ft.Collins,Colorado 80521

本廠建於 1963 年，因設廠位置在 Soldier Canyon Dam（戰士峽谷水壩）之基地而被命名，受管於科羅拉多州東 Larimer county water district (ELCO)半官方組織

水源：水庫(主要來自溶雪)，科羅拉多大湯普森水庫是本州最大的水源。修造於 1938 年和 1957 年之間，提供 30 個城市和鎮用水。也用於灌溉大约 693,000 英畝東北科羅拉多農田。

出水量：冬季日出水量 9MGD（million gallons per day），夏季日出水量 9MGD（million gallons per day）相當我國 3.4 萬~15 萬 CMD 之淨水場。（設計出水量爲 50 MGD）

供水區：Fort Collins-Loveland 、East Larimer County、North Weld County 三個 Water District。

供水人口數：90,000 人

處理流程：1.原水監控 2.化學添加 3.混凝 4.沉澱 5.過濾 6.加氟、加氯 7.監控、實驗室

檢驗、儲存、供配水。爲傳統處理程序之淨水場，全部處理單元皆於室內，反沖水全部回收。

水質檢驗項目：餘氯、pH、鹼度、濁度、硬度、色度、水溫、鐵、鋁、總溶解固體量、鈣、二氧化氯、錳、有機物、無機物、微生物、總有機碳、鹵乙酸、總三鹵甲烷及其他。每年送中央實驗室檢驗一次，報告送環保局核備，同時出版用戶信心報告內容包含淨水場處理程序及水質說明（附錄二）TOC 之水質標準爲原水水質除率 30%，故現場原清水檢驗 TOC。

所有公共給水必須符合美國環境保護署訂定的水質標準(EPA)。該廠的水質符合甚或或超越 EPA 的水質標準。ELCO 每年測試 7,000 個樣品以保證水質符合飲用水標準。要確定水質在供水系統中一直保持穩定，每個月在供水區中收集大約 130 個樣品進行測試。ELCO 維護人員每年從消防水龍頭的排水沖洗管子一次，於水質說明（附錄二）中大方告知顧客因排水揚起的茶色水質是錳的殘留，對身體無害。

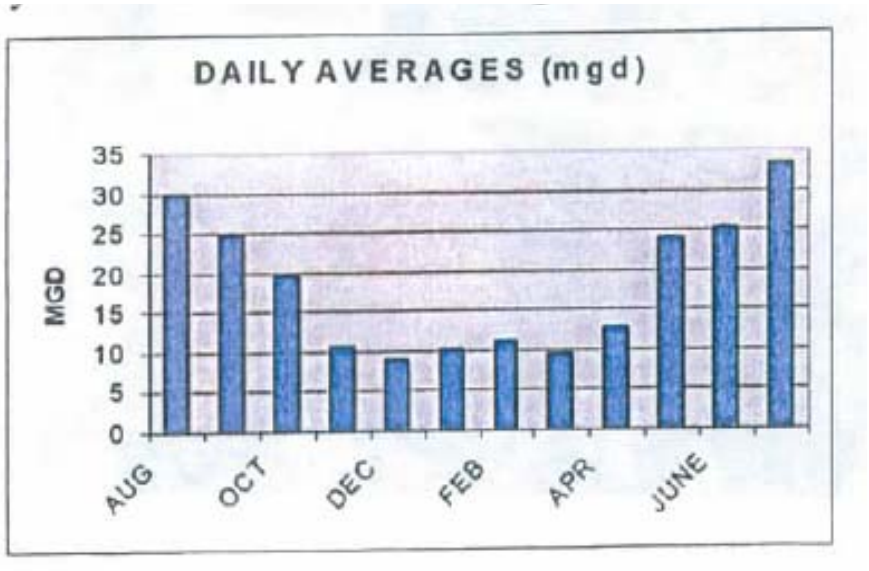

圖 3.Soldier Canyon Filter Plant 平均日出水量

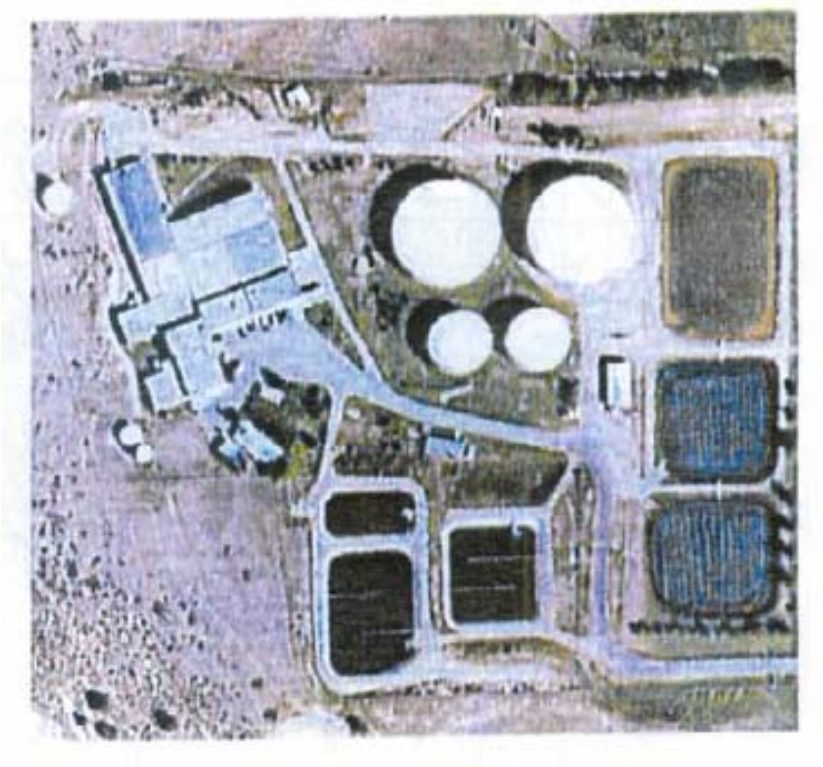

圖 4.Soldier Canyon Filter Plant 廠區平面圖

圖 5.Soldier Canyon Filter Plant 外觀(全部處理設備均於室內)

圖 6.SCADA 系統

圖 7.TOC 監控設備

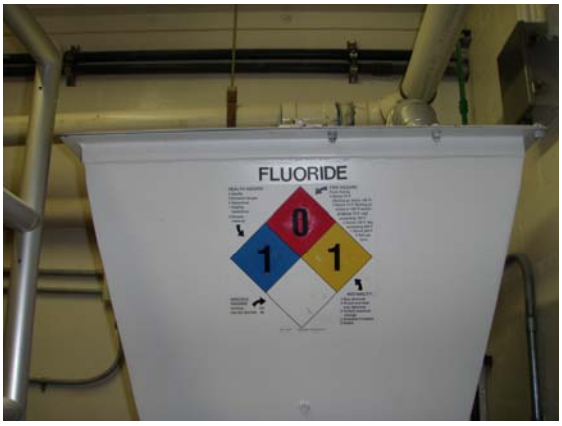

圖 8.加氟設備

圖 9.氟鹽

圖 10.汙泥濃縮池

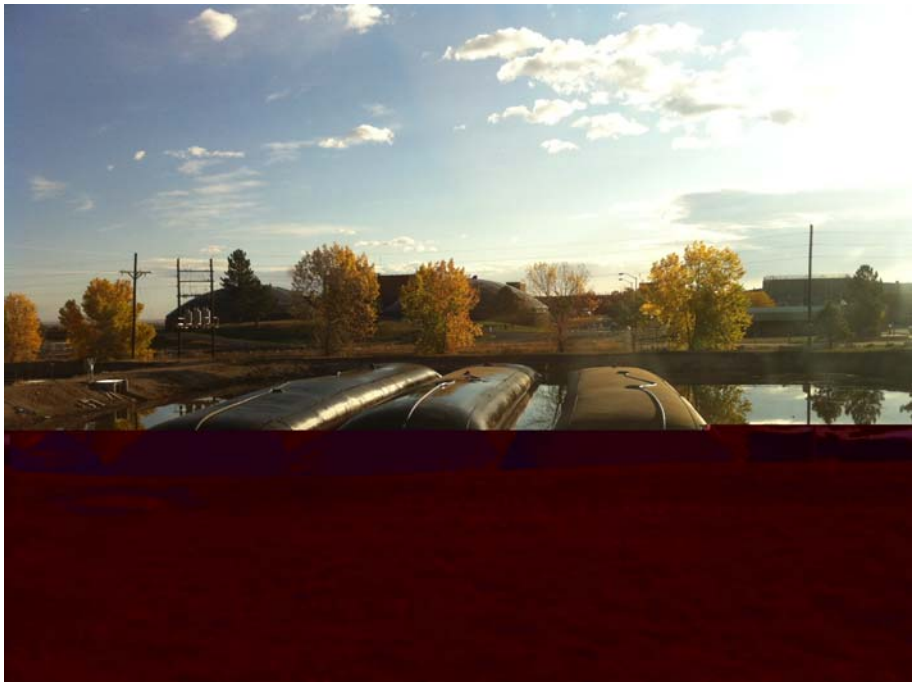

圖 11.污泥以濾袋包裹濾除水分後垃圾掩埋處置

三、 造訪 Lynn R. Morgan Water Treatment Plant

接待人：Paul Anderson（Operator）

電話：303-926-2700

地址：645 Holbrook Street, P.O. Box 750, Erie, CO 80516

建於 2005 年

水源：水庫(主要來自溶雪)

出水量：日出水量 16.7MGD（million gallons per day）

供水區：Erie。

供水戶口：8,100 戶

伊利，科羅拉多的水處理廠是公共用水第一個使用壓力和浸沒式微過濾濾膜系統的淨水場。有效地加倍了淨水廠出水容量。

伊利（Erie）是是美國科羅拉多州 Boulder County 的一個法定小鎮，供水區域內大約有 8,100 住宅及商業帳戶並必須服務其他博爾德縣相鄰地區的客戶。公共工程人員維護超過 124 英里輸水和輸水管，以及規管閥。

根據到 2010 年人口估計美國人口普查是 18,135。伊利正在經歷人口迅速增長，預計將在未來的 15 年的成長三倍。這個巨大的增長，加上乾旱氣候，對小鎮提出嚴苛的水量挑戰。

伊利的水源是科羅拉多大湯普森河(從北科羅拉多管理區)和南巨石城小河。 大湯普森水，鎮的主要水源，從 Carter 湖（大约 30 英里外）的一條地下管道送到淨水場。卡特湖水品質非常好，大約 2NTU；總有機碳（TOC）約 3.6 毫克/L。

林恩 · 摩根水處理設施使用 US Filter 及 CMF-S 浸沒式微濾膜過濾的處理程序，利用先進的膜過程，出水能力從 4.5 MGD 至提高 12.15 MGD。設計兩套不同的先進的水處理系統和優化的性能和操作可持續解決日益增長的缺水問題。此專案增加濾水廠的能力，主力於 TOC 的去除，並減少製造廢物，同時節省金錢和寶貴的水資源。

處理流程：1.原水監控 2.化學添加 3.混凝 4.沉澱 5.濾膜(壓濾法)/真空濾膜 6.活性碳過濾桶 8.加氯 7.監控、實驗室檢驗、儲存、供配水。全部處理單元皆於室內，反沖水直接排至下水道處理系統。

原水經過膠凝沉澱分別進入兩套不同設計之濾膜：

1. 壓力式濾膜：水自內向外經過濾膜濾出，以 CIP 法 (註) 進行維護使用磷酸（去除金屬與無機沉澱物）與次氯酸鈉（去除有機物）清洗沉積於濾膜上的物質，視必要將館內溫度加熱至 40℃以加強清除效果，清除過程結束後將廢液中和去氯後排放至衛生系統。

2. 浸沒式濾膜(CMF-S)以重力流進水低壓抽吸出水的過濾方式，使水從外而內經濾膜過濾，其特色是具有反洗功能裝置，將氣體從內腔反灌吹向膜外將污物帶出系統。

兩種不同設計之濾膜皆可去除懸浮固體物、濁度、色度、水生細菌(包括 E.coli,viruses,Cryptosporidium,Giardia)，水質檢驗集中送中央實驗室檢驗並出具用戶水質信心報告（詳附錄三）

註：Clean in place(CIP) 是不需將管道解體，免除封閉的系統被拆卸和手動清理所產生之污染及拆裝負擔，就能清洗管道的一種方法。CIP 的演進帶給需要頻繁的內部清洗流程的產業帶來的好處是清洗速度更快，少勞動密集型和可重複性，減少人與化學物接觸的風險。CIP 已發展到包括完全自動化的系統的可程式設計邏輯控制器、多個平衡坦克、感測器、閥門、換熱器、資料獲取和特別設計的噴霧噴管系統。

圖 12. Lynn R. Morgan Water Treatment Plant 傳統處理單元

圖 13.高壓濾膜

圖 14.濾心

圖 15. CMF-S

圖 16. CMF-S 之反洗

圖 17. 活性碳過濾桶（夏天水庫亦有臭味問題）

圖 18.與操作人員討論水質

四、　造訪馬里蘭州政府環保局

接待人：Ching-Tzone Tien（Division Chief, State Groundwater Discharge Permits Division）

電話：410-537-3662

地址：1800 Washington Boulevard,Baltimore, Md 21222

馬里蘭州位於波士頓與亞特蘭大大西洋沿海正中地位，在冰河時期結束就開始有人類

活動。早期人類以捕獵和打撈牡蠣爲生。在馬里蘭地區的印地安人以說亞岡昆語的部落爲主。馬里蘭的地形複雜，素有美洲馬里蘭之稱。馬里蘭北鄰賓夕法尼亞州，西接西維吉尼亞州和東部的德拉瓦州和大西洋，並于波托馬克河越過南部，連接西維吉尼亞州和維吉尼亞州。

馬里蘭州鄰近首府華盛頓，全美受高等教育比例爲全國之冠，有 34.5%州民擁有學士以上學位。

- 由於馬里蘭州擁有全美最多的聯邦及私人生化科技研究中心及設備，其中包括國家衛生總署（NIH）及所屬各類醫藥研究中心，約翰霍普金斯大學醫學中心，馬里蘭州稱爲生化科技州當之無愧。

- 資訊電腦及電子通訊已是馬州最大的出口技術及產品，全州在這方面的公司已超過兩千家。馬州及大華府地區的北維州已成爲全美矽谷之外第二電子資訊中心。

- 太空總署的格達中心、海軍航空作戰研發中心以及全美最大的國防工業洛基．馬丁（Lockeed-Martin）均座落馬里蘭州。馬州擁有近五千家與航太有關公司，製造 150,000 航太國防工業高所得就業機會。

圖 19. 與田慶宗博士馬里蘭州政府環保局前留影

馬里蘭州有 5,508,909 人。大部份居民住在中部，也就是巴地摩爾到華盛頓的都會區當中。馬里蘭州的東海岸居住人口較少，大多是農民居住，與南馬里蘭州的狀況相同。至於西馬里蘭州的三個郡，阿雷格尼郡，格雷特郡和華盛頓郡，都是山區地形，人口稀少，直到靠近西維吉尼亞州邊界才比較有大城。在馬里蘭州的居民祖先中，非裔美國人（27.9%）最多，其次是德國人（15.7%）、愛爾蘭人（11.7%）、英國人（9%）和美洲人（5.8%）。

Maryland Department of the Environment（MDE）有大约 900 名雇員。辦公處在巴爾的摩市。並有八個駐外單位。 MDE 提供之服務包括證照許可或 89 種不同的管理設施的稽核，輔助申請許可和鑑定，環境清潔監督、污染防治的技術協助。恢復和維護地面、地下水的質量要求，MDE 強制執行在點和非點污染源的標準和控制，確保環境符合 USEPA 之期望標準（GOAL）。

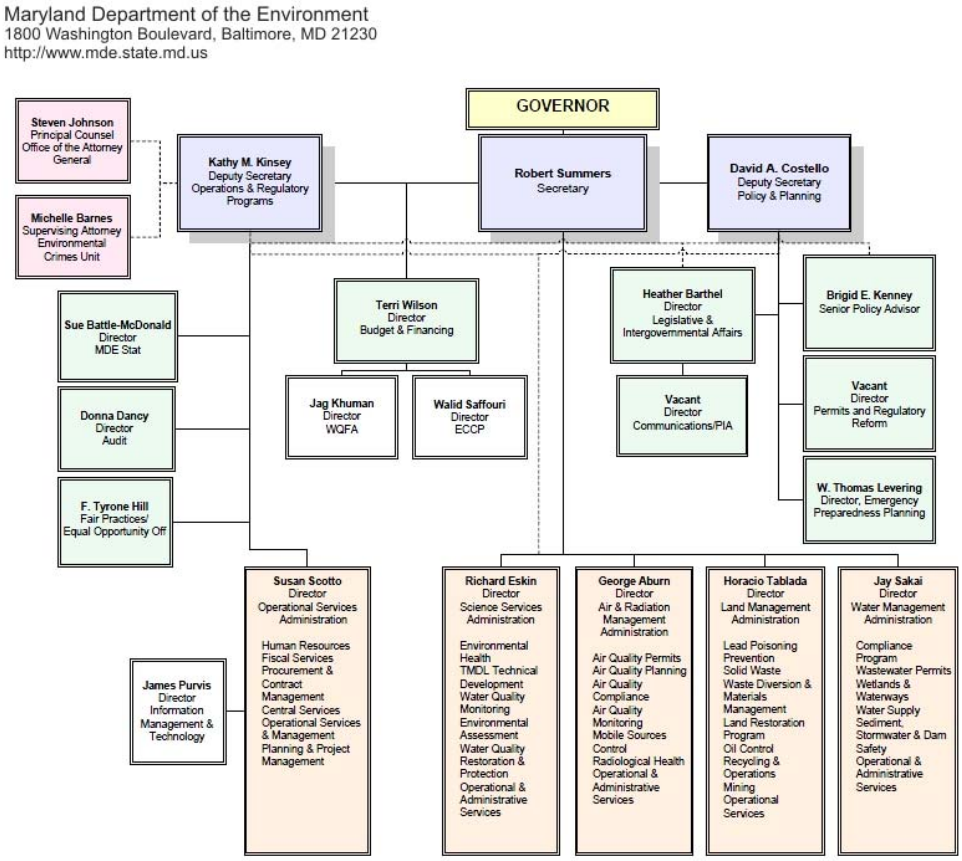

圖 20.馬里蘭州政府環保局組織架構圖

訪談得知：USEPA 訂定水質標準，授權州政府執行，州政府僅針對 primary 標準開罰，水公司每年交付水質檢驗報告給州政府環保局，環保局據以判定水質合不合格需不需要做處理或處罰，環保局不抽驗自來水水質。

美國的淨水場污泥以垃圾掩埋(landfill)處置爲多，有極少數作爲土質調整用途，但須有嚴格檢驗，成份必須合乎規定，一般應符合生物固體改良土壤(biosolid)之規定。

五、 參觀 DHMH 實驗室

因爲自來水公司水質處正計畫建置一個具國際水準的水質檢驗中心，故利用機會前往參觀州政府公共衛生實驗室。

接待人：Taiyin Wei（Supervisor,Trace Metals Laboratory）

電話：410-767-6186

地址：201 W. Preston St.,Baltimore, Md 21201

圖 21.馬里蘭州政府公共衛生實驗室

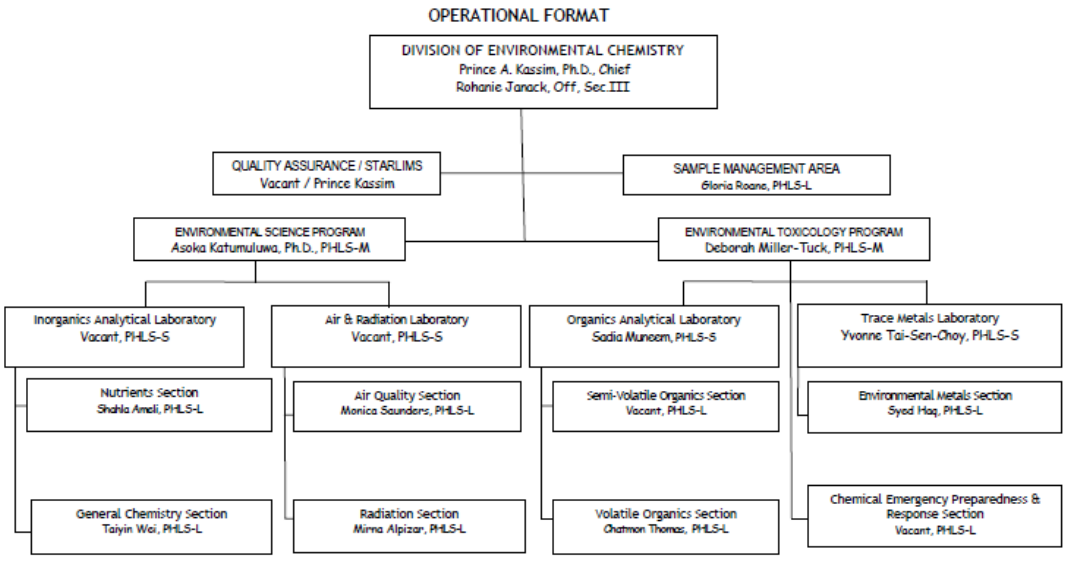

圖 22.馬里蘭州政府公共衛生實驗室組織架構圖

實驗室部門由巴爾的摩中央實驗室和坎伯蘭和索爾茲伯里的區域實驗室組成。大約 300 位科學家和專業人員進駐其中。中央實驗室因其特性之不同區分爲幾個部門，之下擁有超過 40 個專業實驗室。

區域實驗室聘用約 40 名雇員，爲附近縣市的樣品執行基本項目檢驗。較複雜的測試樣品則被發送到中央實驗室。每年人體樣品（血液、尿液等）及環境樣品（空氣、水、食物等）的檢驗量超過 1 千萬件。

爲有效管理數據品質，實驗室亦建置 LIMS 系統，涵蓋的資料有：樣品資料、分析方法、分析人員、分析項目、分析結果、專案管理。

中央實驗室已無法容納日增的工作量，正籌備在 Johns Hopkins 另建新實驗室，時程如下：歷經 12 年（Timeline）

- 2002: New Lab Review Committee Established（新建實驗室執行委員會成立）
- 2003: Committee Reports Submitted（遞交委員會報告）
- 2004: DHMH Adopts New Labs as Capital Project（列入州政府資本預算）
- 2005: Possible Lab Sites Studied（選址）
- 2006: Justification for Cost to Cover First Half of Design Budget（調整價格以支付前半段設計費用）
- 2007: Design Money Reverted, Consultants Requested（設計費恢復，徵詢顧問）
- 2008: Consultants Report on Sizing and Alternate Funding（顧問提出設計報告）
- 2009: $6 Million Initial Design Provided（支付設計首款六百萬）
  MEDCO Bonds Approved（馬里蘭經濟開發公司證實）
- 2010: Architect and Owners Reps Selected（選定建築師與所有人代表）

Design Phase Begins（開始設計階段）

- 2011: Design Continues（繼續設計階段）

Construction to Begin（開始建築施工）

- 2012 - 2013: Construction Continues（繼續建築施工）
- 2014: Construction Complete（建築完工）Move in（遷入）

圖 23.未來馬里蘭州政府公共衛生實驗室外觀設計圖

六、 隨同環保局稽核人員執行 Wellhead Protection 訪查

類似我國水源水質保護區之規定，美國環保署訂有井口保護計畫，旨在防止污染物進入公共給水周圍的土地，社區發展井口保護計畫有六個主要要項

1. 確定該規劃區的規模
2. 由當地有興趣的居民與轄區官員組成專案小組
3. 劃定保護的土地面積。
4. 確定並找到潛在井口保護範圍內的污染物來源。

5. 制定適當程序，保護地下水及確定的污染物來源。

6. 未來的計畫：推動地方建立分區管制、條例，儘量減少未來污染的可能性。

肆、 心得及建議

1. 美國環保單位對所管轄的單位採信任制，不親自對自來水做例行水質抽驗，核發檢驗許可證給水公司或由水公司委託有證照的檢驗公司代爲檢驗水質，報告送環保局備查。水公司對於不符合要求的水質也會誠實申報及告知消費者。此即當初本公司各區管理處檢驗室紛紛申請環保署認證的目的，然而現今的主管機構卻認爲本公司自行檢測的報告不具法定意義，希望將來，我國公務體系的思維可以向已開發國家看齊。

2. 美國的水質標準，僅針對 primary 的標準要求州政府強制執行，對 secondary 的標準則用作指標，不訂定罰則，此種做法較爲合理。

3. 由 Fact Sheet: Stage 2 Disinfectants and Disinfection Byproducts Rule（附件五）知，美國的水質標準執行是採漸進式，給予自來水業者足夠空間去做改善，與本國法規之訂定步調與民意壓力成正比，極大的不同。

4. 戴奧辛毒性快速篩測技術（AhR-PCR），特點是應用戴奧辛類化合物毒性機制，行使聚合酶連鎖反應（Real-time polymerase chain reaction）進行定量，大幅節省分析時間。優點有：分析時間短（24~48 小時）、偵測極限低（1 ppt）、樣品準備容易、成本低、操作步驟簡單，實驗室建置容易。希望水質中心成立後可以引進，必可大大減低目前每年花費兩三百萬委外檢測之費用。

5. 馬里蘭實驗室從籌建到完工預計要花 12 年，或許是台灣的建案效率高，以致無法想像其工期之長，但仍可看出其審慎、有計畫之工作態度。

6. 參觀兩個淨水場不同於我國，處理單元皆於室內，僅一人操作，環境設備乾淨整齊，實值效法。

7. 中空纖維浸沒式超濾膜的平均標稱孔徑爲 0.1~0.2 微米，對微生物形成有效屏障，並且使懸浮在原水或凝結沉澱形成的有機物和無機固體高度濃縮。懸浮固體能夠被完全去除，並產生無菌處理水。與傳統方法相比膜技術加上其廢水處理回收系統採用的生物處理方法(MBR)所帶來的穩定性和環保效益，具有傳統生物處理流程無法比擬的許多結合性優勢。 它產生較好的排放水質，而且其另一優勢使回收水用於反滲透膜系統。與傳統的活性污泥處理方法相比，我們可以將複雜的污染去除過程更爲簡單化。在國內多用於工業廢水處理(借助膜一次濾除病毒、細菌、混濁物以及色素)，Lynn R. Morgan Water Treatment Plant 使用在飲用水效果更佳，如爲降低用地取得成本，不失爲另一考量。

8. 此行隨同馬里蘭環保局外出稽核地下水的保護措施，分成預防與補救兩種，兩者皆與揮發性有機物有關，預防的作法是以水井點源周邊幾里的範圍內抽查工廠是否有違規排放有機污染物，雇主及員工是否有正確的環保意識等等。補救則去勘察一處受污染的土地，處理業者將地下水抽上來曝氣、吸收塔吸附 VOC 以後再回注回地底，曝氣所收集之揮發性有機物則以燃燒方式處置。(馬里蘭的行程因爲屬於公部門的安排，未便同意拍照)

9. 本次出國預算僅編列 7 天，其實稍嫌不足，扣除交通花費的日數，研習無法

深入，建議日後預算編列，如前往較遠的國家，日數勿太短。

伍、 謝誌

此次行程感謝水質處吳美惠處長給予機會，張嬉麗副處長協助聯繫，方得以促成。也謝謝田慶宗博士安排馬里蘭行程，以及田的同事 GINNY 及 TRACY，朋友 PRINCESS 和趙台英小姐不吝指導。911 事件後，美國當局對公務參訪的行程異發保守，感謝今日公司郭美杏小姐及 HACH 公司鄭淇庭先生的安排聯繫，得以參觀當地淨水場，筆者到當地才知道其間遭到多次拒絕，非常不容易，感謝他們的辛勞與用心。

SCREENING FOR POLYCHLORINATED DIBENZO-P-DIOXINS AND FURANS (PCDD/Fs) BY ARYL HYDROCARBON-RECEPTOR PCR ASSAY

SW-846 is not intended to be an analytical training manual. Therefore, method procedures are written based on the assumption that they will be performed by analysts who are formally trained in at least the basic principles of chemical analysis and in the use of the subject technology.

In addition, SW-846 methods, with the exception of required method use for the analysis of method-defined parameters, are intended to be guidance methods which contain general information on how to perform an analytical procedure or technique which a laboratory can use as a basic starting point for generating its own detailed Standard Operating Procedure (SOP), either for its own general use or for a specific project application. The performance data included in this method are for guidance purposes only, and are not intended to be and must not be used as absolute QC acceptance criteria for purposes of laboratory accreditation.

1.0 SCOPE AND APPLICATION

1.1 Method 4430 is a procedure for the screening of Polychlorinated dibenzo-p-dioxins and furans (PCDD/Fs) in soil and sediment. This method uses a commercially available Aryl hydrocarbon Receptor (AhR) based polymerase chain reaction (PCR) assay.. The AhR-PCR assay screens samples by their toxicity equivalent quotient (TEQ) by responding to individual PCDD/F congeners in approximate correlation to their toxicity equivalent factors (TEF). The TEQ measured by the AhR-PCR assay is the sum of the response from the individual congeners. See Table 2 for a detailed list of response factors for individual PCDD/F congeners. More information about the AhR-PCR assay can be found at www.eichrom.com/dioxin/products. EXIT Disclaimer

1.2 The AhR-PCR assay employs AhR proteins extracted from mammalian cells to bind PCDD/Fs. Upon binding PCDD/Fs, the AhR forms an activated receptor complex with an aryl hydrocarbon nuclear translocator (ARNT) and a specific DNA response element (DRE). This activated receptor complex is captured onto a microwell in a 96-well plate and isolated from unreacted AhR, ARNT and DRE by washing on a 96-well plate washer. The level of PCDD/F contamination is then measured indirectly by amplifying and measuring the DRE using real time PCR. Since the interaction of the AhR with individual PCDD/F congeners is proportional to the TEF values of the individual PCDD/F congeners, the response measured by the AhR-PCR assay correlates very well with the TEQ of the sample.

1.3 The AhR-PCR assay and the associated sample preparation method outlined in this document provide a technique for the estimation of the total PCDD/F TEQ. The method will not provide concentrations of individual PCDD/F congeners, as the individual congeners are not separated during the sample preparation. During the sample preparation, the PCDD/Fs are isolated as a group from potentially interfering compounds such as polychlorinated biphenyls (PCB) and polynuclear aromatic hydrocarbons (PAH). A complete list of compounds which have been identified to have significant response on the AhR-PCR assay is provided in Table 2.

1.4 The AhR-PCR assay responds to PCDD/F congeners in proportion to their concentration and TEF value. However, the response factors for individual PCDD/F congeners on the AhR-PCR assay are not identical to the TEF values assigned by the World Health Organization (WHO). Therefore, variation in the accuracy among samples may occur solely

because of variability in congener composition. A comparison of AhR-PCR response factors and WHO TEF values is provided in Table 2.

1.5 This method details a single extraction technique (pressurized fluid extraction, PFE) and sample preparation method which has been shown to effectively extract the PCDD/Fs from soil and sediment samples and isolate the PCDD/Fs from most interfering classes of compounds. Other extraction methods, solvent systems or sample clean-up methods may be used, provided adequate performance of these methods is demonstrated for the analytes of interest from the matrix of interest.

1.6 The limit of detection submitted by the manufacturer of this testing product is 0.4 pg of 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD). This detection limit is provided as guidance only, and the limit achievable by a user for a given sample will be dependent on several factors including the type of sample matrix.

1.7 Prior to employing this method, analysts are advised to consult the base method for each type of procedure that may be employed in the overall analysis (e.g. Methods 3500, 3600, 4000, 5000, and 8000) and the manufacturers instructions for additional information on quality control procedures, development of QC acceptance criteria, calculations, and general guidance. Analysts also should consult the disclaimer statement at the front of the manual and the information in Chapter Two for guidance on the intended flexibility in the choice of methods, apparatus, materials, reagents, and supplies, and on the responsibilities of the analyst for demonstrating that the techniques employed are appropriate for the analytes of interest, in the matrix of interest, and at the levels of concern.

In addition, analysts and data users are advised that, except where explicitly specified in a regulation, the use of SW-846 methods is *not* mandatory in response to Federal testing requirements. The information contained in this method is provided by EPA as guidance to be used by the analyst and the regulated community in making judgments necessary to generate results that meet the data quality objectives for the intended application.

1.8 Use of this method is restricted to use by, or under the supervision of, personnel appropriately experienced and trained in the use of general laboratory techniques including sample extraction, column chromatography and polymerase chain reaction (PCR). Each analyst must demonstrate the ability to generate acceptable results with this method.

2.0 SUMMARY OF METHOD

2.1 Detailed sample preparation and analysis procedures for this method are available in the manufacturer's literature at www.eichrom.com/dioxin/products. EXIT Disclaimer A brief description of the key steps is provided below.

2.2 Diatomaceous earth is added to the dry sample and mixed. The sample is then extracted using pressurized fluid extraction (PFE).

2.3 Following PFE, the solvent is exchanged to hexane, and the PCDD/Fs are isolated from interfering compounds by column chromatography using commercially available silica gels and Florisil. The PCDD/Fs are recovered in 50% methylene chloride:hexane. The sample is concentrated and redissolved in heptane.

2.4 An accurately measured volume of blank, sample, standard or recovery standard in heptane is added to a glass vial containing a mixture of AhR, ARNT and DRE and mixed for one hour.

2.5 An accurately measured volume of the AhR, ARNT, DRE that has been equilibrated with blank, sample, standard or recovery standard for one hour is then added to a plastic microwell and mixed for 30 minutes. PCDD/F-AhR-ARNT-DRE complexes bind to the walls of the microwell, and excess AhR, ARNT and DRE are removed by rinsing on a 96-well plate washer.

2.6 PCR reagents are added to the microwell and the amount of DRE, which is proportional to the TEQ of the sample, is measured using PCR. The response from the PCR is related to TEQ by a dose-response curve generated from 2,3,7,8-TCDD standards. The PCR can analyze up to 38 samples in duplicate, with blanks, standards and recovery standards simultaneously in 90 minutes.

3.0 DEFINITIONS

See the glossary at the end of this method for procedure-specific terms. Also, refer to the SW-846 chapter of terms and acronyms and Methods 8280 and 8290.

4.0 INTERFERENCES

4.1 Solvents, reagents, glassware and other sample processing hardware may yield artifacts and/or interferences to sample analysis. All of these materials must be demonstrated to be free from interferences under the conditions of the analysis by analyzing method blanks. Specific selection of reagents and purification of solvents by distillation in all-glass systems may be necessary. Refer to each method to be used for specific guidance on quality control procedures and to Chapter Four and Method 8290 for general guidance on the cleaning of glassware.

4.2 The AhR used in this method binds to the seventeen PCDD/F congeners with established TEF values, and other aryl hydrocarbon compounds, such as PCBs, PAHs, brominated and mixed brominated/chlorinated dibenzo-p-dioxins and furans, PCDD/F congeners without established TEF values and other compounds similar in structure to 2,3,7,8-TCDD. The highest response is observed for 2,3,7,8-TCDD and compounds of similar structure and degree of chlorination. A complete list of compounds for which the response of the AhR-PCR assay has been observed is given in Table 2.

4.3 The AhR used in this method binds to PCDD/F and similar molecules based on structure, not mass. Therefore, ^{13}Carbon- or other stable isotope labeled standards are detected to the same degree as native compounds. These labeled standards cannot be used as internal standards with this method.

4.4 High levels (10^6 x that of the desired analyte) of selected PAH compounds and high molecular weight aliphatic hydrocarbons have been shown to inhibit the response of the AhR-PCR assay. However, it is unlikely that high levels of these compounds will remain with the PCDD/F fraction if the sample preparation instructions provided by the manufacturer are followed.

5.0 SAFETY

5.1 This method does not address all safety issues associated with its use. The laboratory is responsible for maintaining a safe work environment and a current awareness file

of OSHA regulations regarding the safe handling of the chemicals listed in this method. A reference file of material safety data sheets (MSDS) should be available to all personnel involved in these analyses.

5.2 The AhR-PCR assay should only be used by properly trained personnel in an appropriate laboratory environment. Personnel should wear appropriate personal protective equipment, including safety glasses, lab coat and gloves.

5.3 PCDD/F standards, solutions containing PCDD/Fs and potentially contaminated samples should be treated as hazardous materials.

5.4 Handle all organic solvents (toluene, acetone, hexane, heptane and methylene chloride) in a fume hood.

5.5 Silica gels and Florisil should be treated as respiratory hazards and treated with the appropriate care.

5.6 Silica gels impregnated with sulfuric acid, potassium hydroxide and silver nitrate should be treated with care as they can cause skin irritation, discoloration or burns.

5.7 Some test components are stored in freezers (-20^{o}C and -80^{o}C). Care should be taken to avoid direct contact of frozen components with skin.

6.0 EQUIPMENT AND SUPPLIES

6.1 This section does not list common laboratory glassware (e.g. beakers and flasks). A complete list of the equipment and supplies can be found in the manufacturer's literature (www.eichrom.com/dioxin/products). EXIT Disclaimer

6.2 The AhR-PCR assay requires a real-time PCR instrument with FAM and ROX detection capabilities. Please see the manufacturer's literature for a complete list of compatible models.

6.3 Other significant equipment required for the AhR-PCR assay includes a 96-well platewasher (Biotek Elx50 or equivalent), a 96-well plateshaker (Heidolph Titramax 1000 or equivalent), a refrigerator/freezer (4^{o}C/-20^{o}C) and a -80^{o}C freezer (or liquid nitrogen vial storage Dewar) for storage of the test kit components.

6.4 The manufacturer will supply or specify equipment, apparatus and materials necessary for the successful completion of the test. Do not mix the equipment, supplies or reagents from other test kits. The AhR-PCR assay contains reagents that are evaluated by the manufacturer on a lot to lot basis. Do not mix the reagents from multiple lots, unless expressly allowed by the manufacturer.

6.5 Incorporation of apparatus for the capture of evaporated solvents during concentration procedures may be required by Federal, State or local municipality regulations that govern air emissions of volatile organics. EPA recommends the incorporation of this type of reclamation system as a method to implement an emissions reduction program. Solvent recovery is a means to conform with waste minimization and pollution prevention initiatives.

7.0 REAGENTS AND STANDARDS

7.1 Reagent grade or pesticide grade chemicals must be used in all tests. Unless otherwise indicated, it is intended that all reagents conform to the specifications of the committee of Analytical Reagents of the American Chemical Society, where such specifications are available. Other grades may be used, provided it is first ascertained that the reagent is of sufficiently high purity to permit its use without lessening the accuracy of the determination. Reagents should be stored in glass to prevent the leaching of contaminants from plastic containers.

7.2 Extraction Solvents: This method has been validated using a 3:7 mixture of acetone and toluene for the extraction solvent and a pressurized fluid extraction system. Other solvent systems or another extraction apparatus may also be used provided that they have been shown to provide reproducibly high recovery of the analytes of interest from the matrix of interest. The choice of extraction solvent and apparatus will depend on the analytes of interest and the matrix of interest, and no single solvent or apparatus is universally applicable to all analytes or matrices. Whatever solvent system and apparatus is employed, including those specifically listed in this method, the analyst must demonstrate adequate performance for the analytes of interest, at the levels of interest, from the matrix of interest. At a minimum, such a demonstration will encompass the initial demonstration of proficiency described in method 3500, using a clean reference matrix. Method 8000 describes procedures that may be used to develop performance criteria for such demonstrations as well as for matrix spike and laboratory control sample results.

7.3 Detailed information on reagent requirements are given in the manufacturer's literature (www.eichrom.com/dioxin/products). EXIT Disclaimer Do not mix the equipment, supplies or reagents from different testing products or different lots of the AhR-PCR assay. Store all reagents and standards according to the manufacturer's instructions, and discard any reagents that are past the expiration date assigned by the manufacturer.

8.0 SAMPLE COLLECTION AND STORAGE

Sample collection, preservation and storage requirements may vary by EPA program and may be specified in a regulation or project planning document that requires compliance monitoring for a given contaminant. Where such requirements are specified in the regulation, follow those requirements. In the absence of specific regulatory requirements, use the following information as guidance in determining the sample collection, preservation and storage requirements.

8.1 The AhR-PCR assay requires small sample masses (typically 5-10 grams). Sample collection procedures should ensure that the sample is representative of the source. The distribution of PCDD/Fs in the sample can be heterogeneous. Samples should be homogenized to ensure that any subsamples are representative of the whole sample. Water content should be low enough to avoid standing water in the sample containers and ideally should be removed before homogenizing and subsampling.

8.2 Sample extracts are stable for up to three months when refrigerated (4^{o}C) and stored in tightly sealed vials. Longer storage times may be possible if validated with performance data.

8.3 Store all test kit components as outlined in the manufacturer's literature.

8.4 Some components must be thawed before use. Unless otherwise instructed by the manufacturer, thaw components immediately prior to use to near room temperature. Do not use hot water to thaw components as this can lead to decreased performance of the test.

8.5 Do not use test kits or components after the expiration date.

8.6 Do not use test kit components with components from a different lot of the test kit or with components from test kits from different manufacturers.

9.0 QUALITY CONTROL

9.1 When inconsistencies exist between QC guidelines, method-specific QC criteria take precedence over both technique-specific criteria and those criteria given in Chapter One, and technique-specific QC criteria take precedence over the criteria in Chapter One. Any effort involving the collection of analytical data should include development of a structured and systematic planning document, such as a Quality Assurance Project Plan (QAPP) or a Sampling and Analysis Plan (SAP), which translates project objectives and specifications into directions for those that will implement the project and assess the results. Each laboratory should maintain a formal quality assurance program. The laboratory should also maintain records to document the quality of the data generated. All data sheets and quality control data should be maintained for reference or inspection.

9.2 Refer to Method 3500, 3600, 3620 and 3630 for QC procedures to ensure the proper operation of the various extraction and sample preparation techniques. Any more specific QC procedures provided in this method will supersede those noted in Methods 3500, 3600, 3620 or 3630.

9.3 Before processing any samples, the analyst should demonstrate that all parts of the equipment in contact with the sample and reagents are interference-free. This is accomplished through the analysis of a method blank. Each time samples are extracted, cleaned up, and analyzed, and when there is a change in reagents, a method blank should be prepared and analyzed for the compounds of interest as a safeguard against chronic laboratory contamination.

9.4 Any method blanks, matrix spike samples, or replicate samples should be subjected to the same analytical procedures (Sec. 11.0) as those used on actual samples. For sample extracts that are cleaned up using this method, the associated quality control samples must also be processed through this cleanup method.

9.5 The commercially available testing product used to develop this method represents a performance-based analytical technique. Therefore, it is imperative that the manufacturer's instructions and specifications be followed closely. Follow the manufacturer's instructions for the testing product being used for the quality control procedures specific to that testing product. The following discussion of quality control requirements relies heavily on the analyst's knowledge and understanding of the manufacturer's instructions.

9.6 Stringent quality assurance protocols should be maintained throughout each stage of the testing procedure; i.e., sample extraction, sample preparation, and immunoassay analysis. Various QA actions check for failure at each of these points in the process. Duplicate, check samples, standard reference materials, and other QA samples and methods can and should be used with this kit, with the exception of conventional isotope labelled internal standards. The AhR-PCR assay recognizes PCDD/F congeners based on structure and not on

mass. Therefore, conventional isotope-labelled internal standards are detected as native material and cannot be used with this method.

9.7 As outlined above, routine quality control procedures associated with this method include the measurement of standards, assay blanks, method blanks and recovery standards. It is recommended that all measurements be performed in duplicate and that all measurements be performed as part of the same batch of samples. A batch of samples includes up to 38 field samples prepared and analyzed at the same time, along with standards, assay blanks, method blanks and recovery standards.

9.8 Additional Quality Control Considerations

9.8.1 Do not use test kit components past their expiration dates.

9.8.2 Do not mix the equipment, supplies or reagents from test kits from different manufacturers or from different lots of the test kit.

9.8.3 Use the test components within the storage temperature and operating temperature limits specified by the manufacturer.

9.8.4 The AhR-PCR assay identifies and measures PCDD/F congeners based on structure, not mass. Therefore isotope-labeled internal standards are detected as native material and cannot be used with this method.

10.0 CALIBRATION AND STANDARDIZATION

See the manufacturer's instructions for information on calibration and standardization.

11.0 PROCEDURE

Follow the manufacturer's instructions for the test kit being used. Instructions can be found on the test kit package insert or at www.eichrom.com/dioxin/products. EXIT Disclaimer

12.0 DATA ANALYSIS AND CALCULATIONS

Follow the instructions provided by the manufacturer for the calculation of all testing product results. For each batch of samples, use the calibration curve generated concurrently with that AhR-PCR assay run.

13.0 METHOD PERFORMANCE

13.1 Performance data and related information are provided in SW-846 methods only as examples and guidance. The data do not represent required performance criteria for users of the methods. Instead, performance criteria should be developed on a project-specific basis, and the laboratory should establish in-house QC performance criteria for the application of this method. These performance data are not intended to be and must not be used as absolute QC acceptance criteria for purposes of laboratory accreditation. In the case of this method, any test kits used must be able to meet the performance specifications for the intended application. Also, follow the manufacturer's instructions for quality control procedures specific to the test kit used.

13.2 Table 1 depicts response on the AhR-PCR assay for 2,3,7,8-TCDD over 1 year for four different laboratories along with QA acceptance ranges.

13.3 Table 2 depicts cross-reactivity on the AhR-PCR assay relative to 2,3,7,8-TCDD.

13.4 Table 3 summarizes correlation data for AhR-PCR and GC-HRMS for spiked sand and soil samples.

13.5 Table 4 summarizes correlation data for AhR-PCR and GC-HRMS for real-world soil and sediment samples from US EPA Superfund Sites.

13.6 Table 5 summarizes typical false positive and false negative rates for AhR-PCR near the action level of 50 pg/g TEQ.

13.7 Table 6 summarizes intra-lot variation on the AhR-PCR assay.

13.8 Table 7 summarizes inter-lot variation on the AhR-PCR assay.

14.0 POLLUTION PREVENTION

14.1 Pollution prevention encompasses any technique that reduces or eliminates the quantity and/or toxicity of waste at the point of generation. Numerous opportunities for pollution prevention exist in laboratory operation. The EPA has established a preferred hierarchy of environmental management techniques that places pollution prevention as the management option of first choice. Whenever feasible, laboratory personnel should use pollution prevention techniques to address their waste generation. When wastes cannot be feasibly reduced at the source, the Agency recommends recycling as the next best option.

14.2 For information about pollution prevention that may be applicable to laboratories and research institutions consult *Less is Better: Laboratory Chemical Management for Waste Reduction*, available from the American Chemical Society's Department of Government Relations and Science Policy, 1155 16th St., N.W. Washington, D.C. 20036, (202) 872-4477. http://www.acs.org. EXIT Disclaimer

15.0 WASTE MANAGEMENT

The Environmental Protection Agency requires that laboratory waste management practices be conducted consistent with all applicable rules and regulations. The Agency urges laboratories to protect the air, water, and land by minimizing and controlling all releases from hoods and bench operations, complying with the letter and spirit of any sewer discharge permits and regulations, and by complying with all solid and hazardous waste regulations, particularly the hazardous waste identification rules and land disposal restrictions. For further information on waste management, consult *The Waste Management Manual for Laboratory Personnel*, available from the American Chemical Society at the address listed in Sec. 14.2.

16.0 REFERENCES

1) Dioxins and Furans in Soil and Sediment, Eichrom Method DFS01, www.eichrom.com/dioxin/products. EXIT Disclaimer

2) Van den Berg, M.; Birnbaum, L.S.; Denison, M.; De Vito, M.; Farland, W.; Feeley, M.; Fiedler, H.; Hakansson, H.; Hanberg, A.; Haws, L.; Rose, M.; Safe, S.; Schrenk, D.; Tohyama, C.; Tritscher, A.; Tuomisto, J.; Tysklind, M.; Walker, N.; Peterson, R. E.; The 2005 World Health Organization Reevaluation of Human and Mammalian Toxicity Equivalency Factors for Dioxins and Dioxin-Like Compounds, *Toxicol. Sci.* **2006**, *93[2]*, 223-241.

3) Allen, R.L.; Willey, J.J.; Novel Real-Time PCR Assay for the Detection of Dioxins and Furans, *Organohalogen Compd.* **2002**, *58*, 341-343.

4) McAlister, D.R.; Fern, M.J.; Allen, R.L.; Sakata, K.; Le Bizec, B.; Marchand, P. ; Sample Preparation for the Measurement of Polychlorinated Dioxins and Furans by the Procept Rapid Dioxin Assay, *Organohalogen Compnd.* **2006**, *68*, 940-943.

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6) McAlister, D.R.; Fern, M.J.; Soil Screening at 50 pg/g using a novel Aryl Hydrocarbon Receptor based PCR Assay, *Organohalogen Compd*., **2007**, *69*, 1230-1233.

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11) McAlister, D.R.; Fern, M.J.; Allen, R.L. Rapid Aryl Hydrocarbon Receptor Based Polymerase Chain Reaction Screening Assay for Polychlorinated Dibenzo-p-Dioxins and Furans in Soil and Sediment, *Talanta*, **2007**, in press, doi.org/10.1016/j.talanta.2007.08.005.

17.0 TABLES, DIAGRAMS, FLOWCHARTS, AND VALIDATION DATA

The following pages contain the tables referenced by this method.

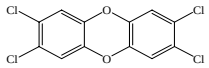
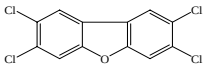
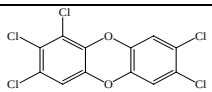
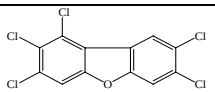
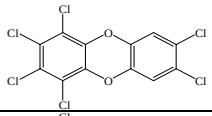
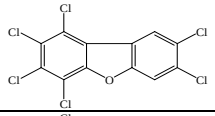
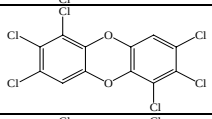
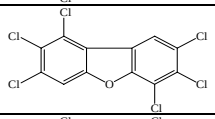
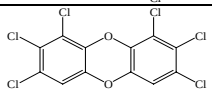
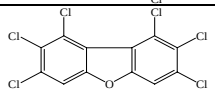
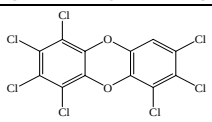
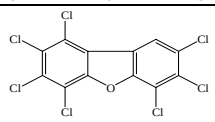
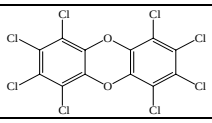
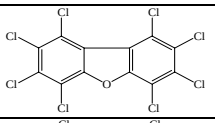
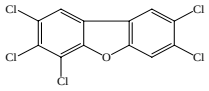
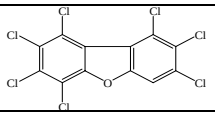
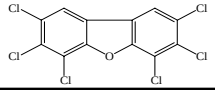
Table 1. Standard Curve Metrics (Ct vs pg/mL 2,3,7,8-TCDD)*

	Eichrom Historical	Eichrom Multi-lab	Multi-lab Site 2	Multi-lab Site 3	Multi-lab Site 4	Acceptable Range
Ct range 0-5000	5.5	5.8	5.7	5.0	4.9	>4.5
R^2 (78-5000)	0.980	0.984	0.992	0.984	0.994	>0.97
average SD of replicates	0.20	0.20	0.20	0.25	0.13	<0.30
number of curves generated	25	6	5	4	3	

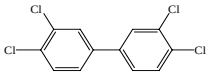
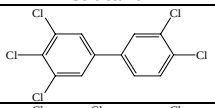
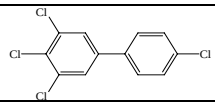
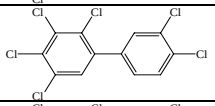
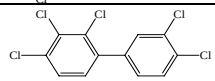
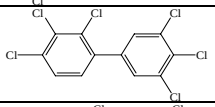
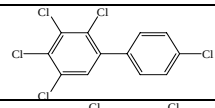
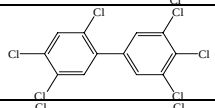
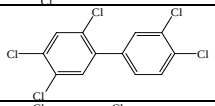
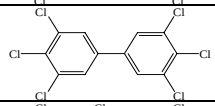
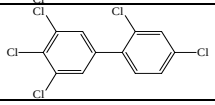
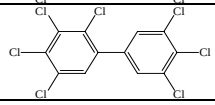
* Data are from 43 determinations of 2,3,7,8-TCDD Response over more than one year for 7 point standard curve + blank in heptane (5000, 2500, 1250, 625, 313, 156, 78 and 0 pg 2,3,7,8-TCDD/mL heptane) generated in four different laboratories. The assay detection limit, approximated from the lowest standard concentration, 78 pg/mL, which lies >3σ from the assay blank, is 0.4 pg 2,3,7,8-TCDD per well. Actual achievable method lower limits of quantitation will depend on several factors including sample size, extract volume and recoveries of analytes through extraction and clean-up steps.

Table 2. Cross-reactivity on the AhR-PCR Assay

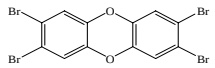
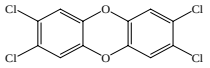
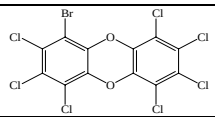
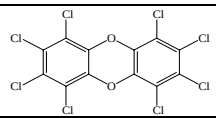
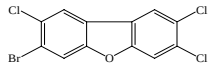
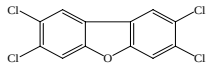
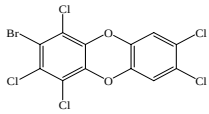
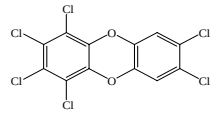
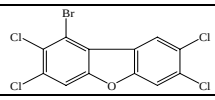
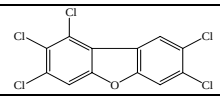
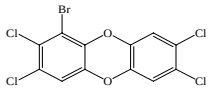
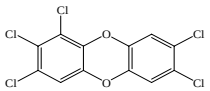
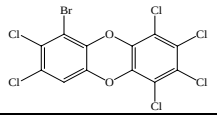
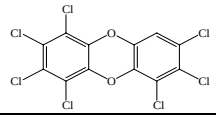
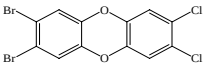
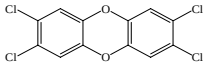
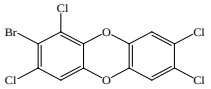
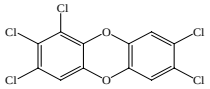
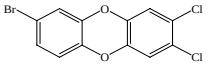
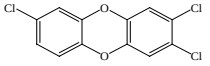
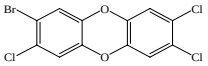
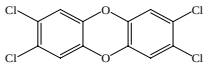
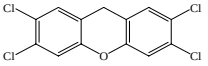
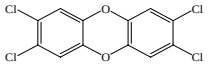
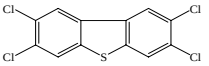
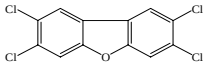
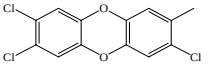
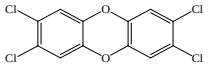
Response for Chlorinated Dioxins and Furans on AhR-PCR Assay

Structure	compound	AhR-PCR Response	compound	AhR-PCR Response	Structure
	2,3,7,8 TCDD	1 TEF(1)	2,3,7,8 TCDF	0.06 TEF (0.1)	
	1,2,3,7,8 PCDD	0.6 TEF (1)	1,2,3,7,8 PCDF	0.1 TEF (0.03)	
	1,2,3,4,7,8 HxCDD	0.4 TEF (0.1)	1,2,3,4,7,8 HxCDF	0.4 TEF (0.1)	
	1,2,3,6,7,8 HxCDD	0.1 TEF (0.1)	1,2,3,6,7,8 HxCDF	0.2 TEF (0.1)	
	1,2,3,7,8,9 HxCDD	0.5 TEF (0.1)	1,2,3,7,8,9 HxCDF	0.3 TEF (0.1)	
	1,2,3,4,6,7,8 HpCDD	0.01 TEF (0.01)	1,2,3,4,6,7,8 HpCDF	0.05 TEF (0.01)	
	1,2,3,4,6,7,8,9 OCDD	0.000003 TEF (0.0003)	1,2,3,4,6,7,8,9 OCDF	0.0005 TEF (0.0003)	
	2,3,4,7,8 PCDF	0.3 TEF (0.3)	1,2,3,4,7,8,9 HpCDF	0.02 TEF (0.01)	
	2,3,4,6,7,8 HxCDF	0.1 TEF (0.1)			

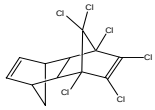
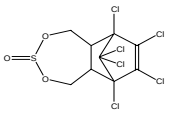
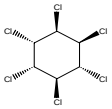
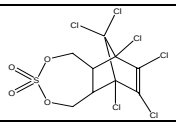
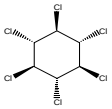
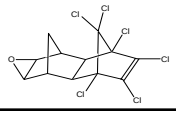
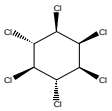
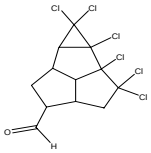
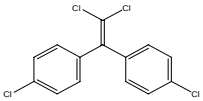
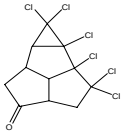
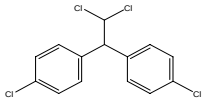
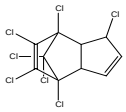
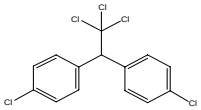
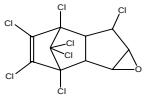
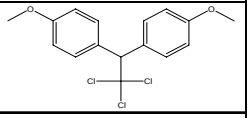
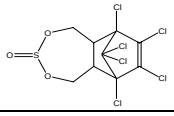
Response for Polychlorinated Biphenyls on AhR-PCR Assay

Structure	compound	AhR-PCR Response	compound	AhR-PCR Response	Structure
	PCB-77 (3,3',4,4')	0.00003 TEF (0.0001)	PCB-126 (3,3',4,4',5)	0.01 TEF (0.1)	
	PCB-81 (3,4,4',5)	0.00005 TEF (0.0003)	PCB-156 (2,3,3',4,4',5)	0.00003 TEF (0.00003)	
	PCB-105 (2,3,3',4,4')	<3 x 10-7 TEF (0.00003)	PCB-157 (2,3,3',4,4',5')	0.00004 TEF (0.00003)	
	PCB-114 (2,3,4,4',5)	0.00001 TEF (0.00003)	PCB-167 (2,3',4,4',5,5')	0.000001 TEF (0.00003)	
	PCB-118 (2,3',4,4',5)	<3 x 10-7 TEF (0.00003)	PCB-169 (3,3',4,4',5,5')	0.001 TEF (0.03)	
	PCB-123 (2',3,4,4',5)	0.000009 TEF (0.00003)	PCB-189 (2,3,3',4,4',5,5')	<3 x 10-7 TEF (0.00003)	

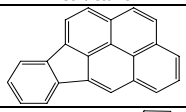
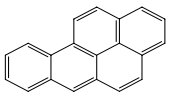
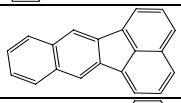
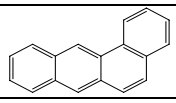
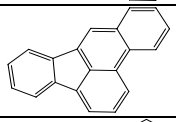
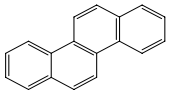
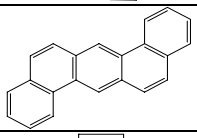
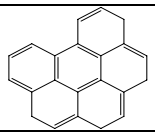
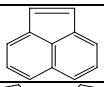
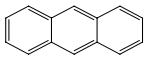
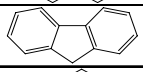
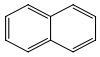
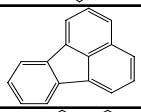
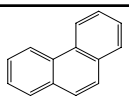
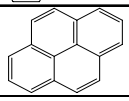
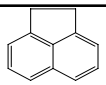
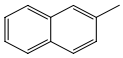
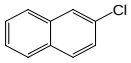
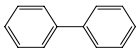
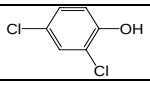
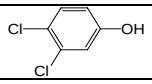
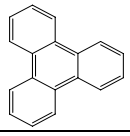
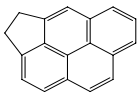
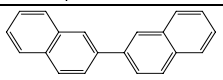
Response for Bromo/chloro Dioxins and Furans on AhR-PCR Assay

Structure	compound	AhR-PCR Response	analogous chloro-compound	AhR-PCR Response	Structure
	2,3,7,8-TBrDD	0.3	2,3,7,8-TCDD	1.0	
	1-Br-2,3,4,6,7,8,9-HpCDD	0.00004	1,2,3,4,6,7,8,9-OCDD	0.000003	
	3-Br-2,7,8-TriCDF	0.4	2,3,7,8-TCDF	0.1	
	2-Br-3,6,7,8,9-PCDD	0.05	1,2,3,4,7,8-HxDD	0.4	
	1-Br-2,3,7,8-TCDF	0.3	1,2,3,7,8-PCDF	0.1	
	1-Br-2,3,7,8-TCDD	0.4	1,2,3,7,8-PCDD	0.6	
	1-Br-2,3,6,7,8,9-HxCDD	0.06	1,2,3,4,6,7,8-HpCDD	0.01	
	2,3-Br-7,8-DiCDD	0.4	2,3,7,8-TCDD	1.0	
	2-Br-1,3,7,8-TCDD	0.6	1,2,3,7,8-PCDD	0.6	
	2-Br-7,8-DiCDD	$<10^{-6}$	2,3,7-TriCDD	N/A	
	2-Br-3,7,8-TriCDD	0.5	2,3,7,8-TCDD	1.0	
	2,3,6,7-TCl-xanthene	0.7	2,3,7,8-TCDD	1.0	
	2,3,7,8-TCl-thiophene	0.2	2,3,7,8-TCDF	0.1	
	2,3,7-Cl-8-methyl-dibenzo-p-dioxin	0.3	2,3,7,8-TCDD	1.0	

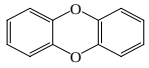
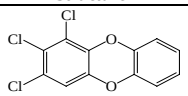
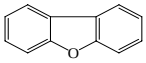
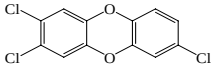
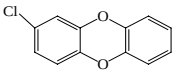
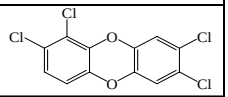
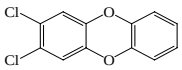
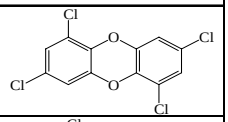
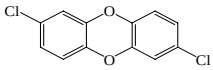
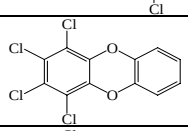
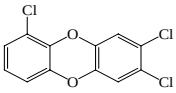
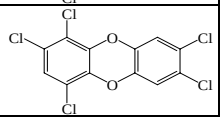
Response of Pesticide Compounds on AhR-PCR Assay

Structure	Compound	AhR-PCR Response	Compound	AhR-PCR Response	Structure
	aldrin	no measurable response from 2000 ppt to 2000 ppm	Endosulfan II	no measurable response from 2000 ppt to 2000 ppm	
	alpha-BHC	no measurable response from 2000 ppt to 2000 ppm	Endosulfan sulfate	no measurable response from 2000 ppt to 2000 ppm	
	beta-BHC	no measurable response from 2000 ppt to 2000 ppm	Endrin	no measurable response from 2000 ppt to 2000 ppm	
	delta-DHC	no measurable response from 2000 ppt to 2000 ppm	Endrin Aldehyde	no measurable response from 2000 ppt to 2000 ppm	
	p,p'-DDE	no measurable response from 2000 ppt to 2000 ppm	Endrin Ketone	no measurable response from 2000 ppt to 2000 ppm	
	p,p'-DDD	no measurable response from 2000 ppt to 2000 ppm	Heptachlor	no measurable response from 2000 ppt to 2000 ppm	
	p,p'-DDT	no measurable response from 2000 ppt to 2000 ppm	Heptachlor epoxide	no measurable response from 2000 ppt to 2000 ppm	
	Dieldrin	no measurable response from 2000 ppt to 2000 ppm	Methoxychlor	no measurable response from 2000 ppt to 2000 ppm	
	Endosulfan I	no measurable response from 2000 ppt to 2000 ppm			

Response of PAH Compounds on AhR-PCR Assay

structure	compound	AhR-PCR Response	compound	AhR-PCR Response	Structure
	Indeno(1,2,3-cd)pyrene	0.8	Benzo(a)pyrene	0.1	
	Benzo(k)fluoranthene	0.5	Benzo(a)anthracene	0.05	
	Benzo(b)fluoranthene	0.6	Chrysene	0.04	
	Dibenzo(ah)anthracene	0.3	Benzo(ghi)perylene	0.004	
	acenaphthylene	No response at 200 ppt to 10 ppm	anthracene	No response at 200 ppt to 10 ppm	
	fluorene	No response at 200 ppt to 10 ppm	naphthalene	No response at 200 ppt to 10 ppm	
	fluoranthene	No response at 200 ppt to 10 ppm	phenanthrene	No response at 200 ppt to 10 ppm	
	pyrene	No response at 200 ppt to 10 ppm	acenaphthene	No response at 200 ppt to 10 ppm	
	2-methylnaphthalene	No response at 200 ppt to 10 ppm	2-chloronaphthalene	No response at 200 ppt to 10 ppm	
	biphenyl	No response at 200 ppt to 10 ppm	2,4-dichlorophenol	No response at 200 ppt to 10 ppm	
	3,4-dichlorophenol	No response at 200 ppt to 10 ppm	toluene	No response at 200 ppt to 10 ppm	
	triphenylene	0.001	cyclopenta[c,d]pyrene	0.0002	
	2,2'-binaphthyl	0.05			

Response of non-2,3,7,8 Dioxins/Furans on AhR-PCR Assay

structure	compound	AhR-PCR Response	compound	AhR-PCR Response	Structure
	dibenzo-p-dioxin	$< 10^{-6}$	1,2,3-TriCDD	0.006	
	dibenzo-p-furan	$< 10^{-6}$	2,3,7-TriCDD	0.08	
	2-MCDD	$< 10^{-6}$	1,2,7,8-TCDD	0.9	
	2,3-DiCDD	$< 10^{-6}$	1,3,6,8-TCDD	0.001	
	2,7-DiCDD	$< 10^{-6}$	1,2,3,4-TCDD	0.007	
	1,7,8-TriCDD	0.004	1,2,4,7,8-PCDD	0.3	

Response of Miscellaneous Compounds on AhR-PCR Assay

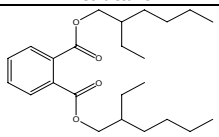
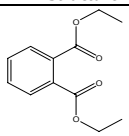
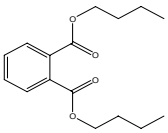
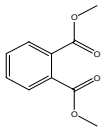
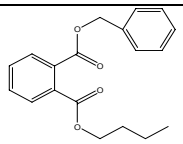
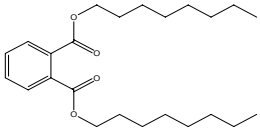
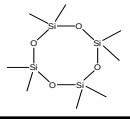
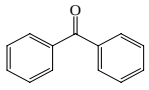
structure	compound	AhR-PCR Response	compound	AhR-PCR Response	Structure
	bis-(2-ethylhexyl)phthalate	$< 7 \times 10^{-7}$	diethylphthalate	$< 7 \times 10^{-7}$	
	di-n-butylphthalate	$< 7 \times 10^{-7}$	dimethylphthalate	$< 7 \times 10^{-7}$	
	butylbenzylphthalate	$< 7 \times 10^{-7}$	di-n-octylphthalate	$< 7 \times 10^{-7}$	
$C_{10}H_{22}$	decane	$< 9 \times 10^{-7}$	eicosane	$< 9 \times 10^{-7}$	$C_{20}H_{42}$
$C_{12}H_{26}$	dodecane	$< 9 \times 10^{-7}$	docosane	$< 9 \times 10^{-7}$	$C_{22}H_{246}$
$C_{14}H_{30}$	tetradecane	$< 9 \times 10^{-7}$	tetracosane	$< 9 \times 10^{-7}$	$C_{24}H_{50}$
$C_{16}H_{34}$	hexadecane	$< 9 \times 10^{-7}$	hexacosane	$< 9 \times 10^{-7}$	$C_{26}H_{54}$
$C_{18}H_{38}$	octadecane	$< 9 \times 10^{-7}$	octacosane	$< 9 \times 10^{-7}$	$C_{28}H_{58}$
	octamethylcyclotetrasiloxane	no measurable response from 2000 ppt to 2000 ppm	benzophenone	$< 1 \times 10^{-6}$	

Table 3. Correlation of AhR-PCR with GC-HRMS for Spiked sand and loamy soil

sand			loamy soil		
GC-MS TEQ	AhR-PCR TEQ	50pg/g screen	GC-MS TEQ	AhR-PCR TEQ	50pg/g screen
0.03	0.6	CN	0.03	0.4	CN
0.03	0.4	CN	0.03	0.3	CN
0.03	0.8	CN	0.03	0.5	CN
0.03	0.4	CN	0.03	0.5	CN
0.03	0.6	CN	0.03	0.4	CN
0.03	0.6	CN	0.03	0.3	CN
5	6.9	CN	5	4.8	CN
5	5.9	CN	5	3.6	CN
5	4.6	CN	5	6.0	CN
5	4.9	CN	5	3.7	CN
5	4.7	CN	5	3.3	CN
5	4.5	CN	5	3.1	CN
25	22	CN	25	30	CN
25	29	CN	25	22	CN
25	29	CN	25	26	CN
25	28	CN	25	21	CN
25	35	CN	25	32	CN
25	22	CN	25	28	CN
50	45	FN	50	54	CP
50	50	CP	50	48	FN
50	52	CP	50	66	CP
50	31	FN	50	39	FN
50	62	CP	50	37	FN
50	76	CP	50	29	FN
75	80	CP	75	74	CP
75	90	CP	75	59	CP
75	103	CP	75	54	CP
75	82	CP	75	75	CP
75	83	CP	75	84	CP
75	52	CP	75	65	CP
500	610	CP	500	534	CP
500	652	CP	500	305	CP
500	627	CP	500	409	CP
500	372	CP	500	467	CP
500	646	CP	500	483	CP
500	497	CP	500	306	CP
1000	1275	CP	1000	939	CP
1000	1006	CP	1000	898	CP
1000	1078	CP	1000	771	CP
1000	710	CP	1000	1007	CP
1000	720	CP	1000	937	CP
1000	1040	CP	1000	930	CP
1500	1126	CP	1500	1214	CP
1500	1224	CP	1500	1187	CP
1500	1570	CP	1500	1168	CP
1500	876	CP	1500	961	CP
1500	1584	CP	1500	1234	CP
1500	1538	CP	1500	1293	CP

CP = Correct Positive, CN = Correct Negative, FP = False Positive, FN = False Negative

Table 4. Correlation of GC-HRMS and AhR-PCR Assay for Real World Soils

Raritan Bay Sediment

GC-HRMS TEQ (pg/g)	AhR-PCR TEQ (pg/g)	50pg/g screen
0.03	0.6	CN
14	14	CN
14	11	CN
14	6.8	CN
14	14	CN
12	8.8	CN
12	3.9	CN
12	11	CN
12	10	CN
15	15	CN
15	10	CN
15	10	CN
15	10	CN
14	15	CN
14	8.4	CN
14	15	CN
14	9.3	CN
13	14	CN
13	10	CN
13	10	CN
13	10	CN

Newark Bay Sediment

GC-HRMS TEQ (pg/g)	AhR-PCR TEQ (pg/g)	50pg/g screen
0.03	2.1	CN
16	22	CN
16	18	CN
16	17	CN
16	19	CN
32	32	CN
32	37	CN
32	35	CN
32	25	CN
38	29	CN
38	36	CN
38	43	CN
38	26	CN
45	53	FP
45	40	CN
45	44	CN
45	36	CN
62	61	CP
62	55	CP
62	45	FN
62	37	FN

Tittabawasse River Soil

GC-HRMS TEQ (pg/g)	AhR-PCR TEQ (pg/g)	50pg/g screen
0.03	0.7	CN
0.03	1	CN
0.03	1	CN
0.03	1	CN
42	62	FP
42	21	CN
42	26	CN
42	21	CN
435	435	CP
435	637	CP
435	406	CP
435	255	CP
808	597	CP
808	2383	CP
808	423	CP
808	1276	CP
1048	1246	CP
1048	1136	CP
1048	1237	CP
1048	877	CP
3127	1548	CP
3127	995	CP
3127	5578	CP
3127	3083	CP

Solutia Soils

GC-HRMS TEQ (pg/g)	AhR-PCR TEQ (pg/g)	50pg/g screen
0.03	6.2	CN
48	359	FP
48	465	FP
48	479	FP
48	371	FP
846	721	CP
846	667	CP
846	541	CP
846	466	CP
1279	859	CP
1279	1201	CP
1279	599	CP
1279	1123	CP
1833	1833	CP
1833	1938	CP
1833	1516	CP
1833	1243	CP
3257	4541	CP
3257	3083	CP
3257	2944	CP
3257	2692	CP
3951	4631	CP
3951	3935	CP
3951	3214	CP
3951	3352	CP

Winona Post Soils

GC-HRMS TEQ (pg/g)	AhR-PCR TEQ (pg/g)	50pg/g screen
0.03	5.2	CN
8648	16393	CP
8648	6684	CP
8648	9972	CP
8648	12430	CP
8831	9889	CP
8831	10716	CP
8831	9183	CP
8831	19528	CP
11071	11018	CP
11071	17503	CP
11071	20696	CP
11071	28013	CP
11259	33839	CP
11259	8139	CP
11259	7410	CP
11259	26151	CP
11410	15053	CP
11410	15297	CP
11410	7100	CP
11410	12760	CP

Table 5. Example False Positive and Negative Rates Near Action Level (50pg/g)

Spiked Sand			Spiked Soil		
GC-MS TEQ (pg/g)	**Procept TEQ (pg/g)**	**Screen at 50 pg/g Result**	**GC-MS TEQ (pg/g)**	**Procept TEQ (pg/g)**	**Screen at 50 pg/g Result**
25	22	True Negative	25	30	True Negative
25	29	True Negative	25	22	True Negative
25	29	True Negative	25	26	True Negative
25	28	True Negative	25	21	True Negative
25	35	True Negative	25	32	True Negative
25	22	True Negative	25	28	True Negative
75	80	True Positive	75	74	True Positive
75	90	True Positive	75	59	True Positive
75	103	True Positive	75	54	True Positive
75	82	True Positive	75	75	True Positive
75	83	True Positive	75	84	True Positive
75	52	True Positive	75	65	True Positive

Table 6. Same lot variation of Measurement

Spiked Sample[1] (pg/g TEQ)	Mean Procept Response (ppt)[2]	Standard Deviation[2]	% RSD[2,3]	% Recovery[4]
Blank	0.8	0.1	17	N/A
5.0	6.3	0.7	12	126
25	26	5.0	20	104
50	46	10	22	91
75	70	15	21	93
500	720	130	18	143
1000	1400	260	19	138
1500	1900	460	24	127

[1]Sand matrix spiked with 7 Dibenzo-*p* -Dioxin/Furan Standards (tetra-hexachloro)

[2]Eight measurements at each concentration on single lot of test kit on same day

[3]Relative standard deviation (standard deviation*100%/mean value)

[4](Mean AhR-PCR Response)*100%/Spike Concentration (pg/g TEQ)

Table 7. Variation of Measurement Between 3 Lots

Spiked Sample[1] (pg/g TEQ)	mean lot 101806[2]	mean lot 01106[2]	mean lot 033006[2]	Inter-lot Mean AhR-PCR Response (pg/g TEQ)	Inter-lot % RSD[3]
Blank	0.8	0.3	0.4	0.5	61
5.0	6.3	8.4	8.2	7.6	15
25	26	32	36	31	16
50	46	51	43	46	9
75	70	62	83	72	15
500	720	560	620	630	13
1000	1400	1200	1400	1300	9
1500	1900	1400	1500	1600	17

[1]Sand matrix spiked with 7 Dibenzo-*p*-Dioxin/Furan Standards (tetra-hexachloro)

[2]Mean of Four to Eight measurements on each lot

[3]Relative standard deviation (standard deviation*100%/mean value)

GLOSSARY OF TERMS

2,3,7,8-TCDD – 2,3,7,8-tetrachlorodibenzo-p-dioxin

AhR – Aryl hydrocarbon receptor

ARNT – Aryl hydrocarbon receptor nuclear translocator protein.

Congener – Compounds containing different numbers and position of chlorine atoms (or other substituent) on the same base structure.

Ct – Threshold Cycle. This is the output of the real-time PCR instrument. Threshold cycle corresponds to the number of PCR temperature cycles at which the measured fluorescence of a sample well exceeds a threshold value. The threshold value is set by the user, or software, to optimize the linearity of the standard curve. Comparing the Ct of an unknown sample to an appropriate standard curve allows the analyst to relate Ct to concentration or TEQ.

DRE - DNA response element

PAHs – Polycyclic aromatic hydrocarbons

PCBs- Polychlorinated biphenyls

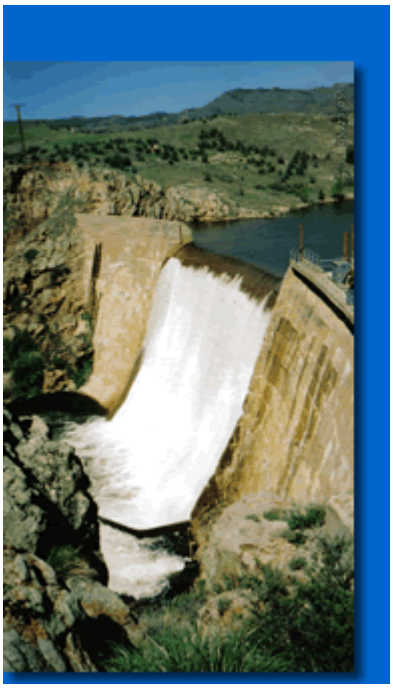
PCDD/Fs – Polychlorinated dibenzo-p-dioxins and furans.

PCR- Polymerase chain reaction. A technique employed to replicate and measure the concentration of DNA fragments.

TEF (Toxicity Equivalent Factor) – Toxicity values established by the World Health Organization (WHO) for chlorinated dibenzo-p-dioxins and furans and polychlorinated biphenyls relative to 2,3,7,8-tetrachlorodibenzo-p-dioxin.

TEQ (Toxicity Equivalent Quotient) – The sum of the concentration of dioxin congeners multiplied by their TEF value. TEQ = ∑(congener concentration)x(TEF).

ELCO Water Quality



Even though ELCO's water originates in pristine areas high in the Rocky Mountains, it undergoes extensive treatment and testing at the Soldier Canyon Filter Plant. All public water suppliers must meet stringent water quality criteria set by the U.S. Environmental Protection Agency (EPA). The EPA has established maximum contaminant levels for compounds that may have an adverse effect on human health.

Water from the Soldier Canyon Filter Plant consistently meets or exceeds all water quality standards established by the EPA. Over 7,000 tests are conducted at the Filter plant each year to ensure that ELCO water meets all applicable drinking water standards.

To make sure water quality is maintained all the way to the customer, approximately 130 tests are performed each month on water supply samples collected throughout the District. District personnel also flush water from fire hydrants each year to clean out the pipes that deliver water to ELCO customers.

Fire hydrant flushing and water main breaks may stir up sediment that has settled in the pipes. Most of the sediment is manganese from Horsetooth Reservoir. The filter plant removes most of the manganese but a small amount still gets through. Manganese is not harmful, but it may taste bad and make tap water look like weak tea.

Water quality problems are usually temporary. Customers who notice a change in their water are encouraged to contact the ELCO office.

ELCO water is completely safe for drinking, cooking, bathing and other household uses. There is no need to perform additional treatment on water delivered by ELCO.

Small amounts of chlorine and flouride are added to the water as it leaves the Soldier Canyon Filter Plant. Chlorine is added to kill any bacteria which may still be in the water. Fluoride is added to help reduce tooth decay.

Some customers may not like the taste of soft water or may prefer to drink water that does not contain chlorine or fluoride. Those customers may want to buy bottled water or install a home treatment device for these reasons. Customers who drink bottled water or water from a home treatment device should do so because they prefer the taste, not out of concern for the safety of water provided by ELCO.

Annual Water Quality Report

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Source of ELCO's Water

ELCO receives treated water from the Soldier Canyon Filter Plant, so named because of its location at the base of the Soldier Canyon Dam. The Soldier Canyon Dam is one of four dams constructed west of Fort Collins by the Bureau of Reclamation in the 1940's to create Horsetooth Reservoir.

Water in Horsetooth Reservoir originates as snow in the upper reaches of the Colorado River Basin. Snowmelt is collected in reservoirs on the western slope and diverted through a series of tunnels and canals for use in northeastern Colorado.

ELCO Water District, North Weld County Water District and the Fort Collins-Loveland Water District jointly own and operate the Soldier Canyon Filter Plant. Through connections with the three Districts that own the Plant, water is also supplied to the towns of Windsor, Ault, Nunn, Severance, Timnath and Eaton, as well as portions of Pierce and the Northern Colorado Water Association. Approximately 75,000 residents of northern Colorado currently receive drinking water from the Soldier Canyon Filter Plant.

Most of the water treated at the Soldier Canyon Filter Plant comes directly out of Horsetooth Reservoir through an outlet in the Soldier Canyon dam. At this time, approximately 10% of the water treated at the Soldier Canyon Filter Plant originates in the Poudre River. The percentage of Poudre River water treated and delivered to ELCO customers will increase as time goes on. By the Year 2030, it is expected that equal amounts of Horsetooth and Poudre River water will be treated at Soldier Canyon.

Poudre River water is delivered to the Soldier Canyon Filter Plant through the Pleasant Valley Pipeline, an eight mile-long raw water transmission line that also serves water treatment plants owned by Fort Collins and Greeley.

Horsetooth Reservoir and the Pleasant Valley Pipeline are part of the Colorado-Big Thompson (C-BT) Project, the largest transmountain diversion project in the State. The Northern Colorado Water Conservancy District administers the C-BT Project. The Conservancy District oversees the delivery of water for agricultural, municipal and industrial uses to almost 1.5 million acres of northeastern Colorado.

Protect Your Water Supply

ELCO customers receive high quality drinking water from a modern, well-operated water treatment facility supplied by the Poudre River and Horsetooth Reservoir. Fortunately, both sources are relatively safe from contamination or degradation. It can remain that way with assistance from those who use the reservoir and its watershed.

Contaminants in water sources have the potential of adversely affecting the quality of your drinking water. The water treatment plant removes most contamination, but it would be better if contaminates never entered the river or reservoir.

Everyone lives, works and plays in the watershed of some lake or river. To protect the water supply of ELCO and nearby communities, residents of northern Colorado need to avoid activities that can threaten the region's waterways.

Those who enjoy recreational activities in or near Colorado's lakes and rivers need to be sure their activities do not adversely affect water quality. Precautions are necessary to prevent fertilizers and chemicals applied to lawns or crops from ending up in waterways. Hazardous household waste or industrial chemicals can threaten water quality if not disposed of properly. Poor land use and construction practices can contribute to sedimentation problems. Everyone must remember that Colorado's lakes and streams are a source of drinking water for many people; we have the right and the responsibility to preserve and protect those waters.

elco Annual Water Quality Report

Office Hours and Location

The ELCO office is located at 232 South Link Lane, Fort Collins, Colorado and is open from 8:00 a.m. to 4:30 p.m., Monday through Friday. The phone number is 970-493-2044.

Emergencies

Customers in need of emergency service can call 970-493-2044 after regular office hours. Emergency calls are routed to an answering service which can dispatch on-call personnel.

For Your Information

This report and other important information about ELCO Water District can be found on the District's website. The address is: **www.elcowater.org**

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Introduction

East Larimer County (ELCO) Water District has been providing its customers with a reliable source of high quality drinking water since 1962. Last year, ELCO delivered approximately 1 billion gallons of water to the 5,800 customer accounts within the District. Rigorous testing of water delivered to ELCO customers last year showed no violation of the health-based standards established by regulatory agencies.

Thousands of tests are performed each year on water supplied to ELCO customers. Most tests are performed at the water treatment plant to monitor the operation and efficiency of the treatment facility. ELCO and treatment plant operators must also perform tests that show compliance with all applicable water quality regulations.

The regulatory test results included in this report are routinely filed with the Colorado Department of Health and the Environmental Protection Agency (EPA). Since 1999, ELCO and all other water suppliers within the United States have been required to provide an annual Water Quality Report to their customers.

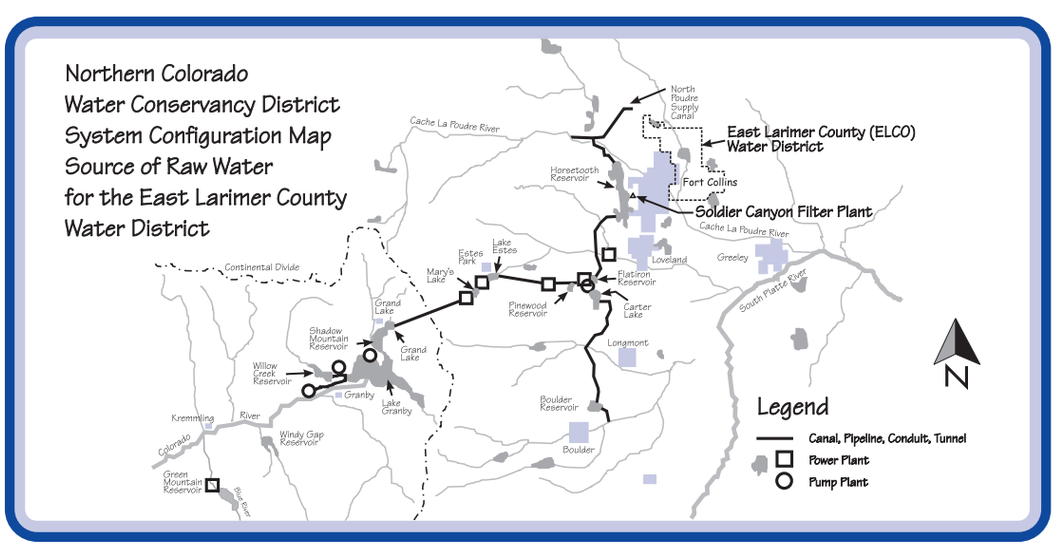
Where does ELCO water come from?

ELCO receives treated water from the Soldier Canyon Filter Plant, located at the base of the Soldier Canyon Dam on Horsetooth Reservoir. Water treated at the Soldier Canyon Filter Plant comes directly out of Horsetooth Reservoir, and the Poudre River through the Pleasant Valley Pipeline. Once water rights owned or controlled by the District have been converted from agricultural to municipal use, it is expected that half of the District's water will be diverted from the Poudre.

ELCO Water District, North Weld County Water District and the Fort Collins-Loveland Water District jointly own and operate the Soldier Canyon Filter Plant. Through connections with the three Districts that own the plant, water is also supplied to the towns of Windsor, Eaton, Ault, Severance, Timnath, Pierce and Nunn as well as the Sunset Water District and portions of the Northern Colorado Water Association. Approximately 75,000 residents in northern Colorado receive their water from the Soldier Canyon Filter Plant.

Water in Horsetooth Reservoir originates as snow in the upper reaches of the Colorado River basin. Snowmelt is collected in reservoirs on the western slope of the Rocky Mountains and diverted through a series of tunnels and canals for use in northeastern Colorado.

Horsetooth Reservoir is part of the Colorado-Big Thompson (C-BT) Project, the largest transmountain diversion project in the state. The C-BT project is administered by the Northern Colorado Water Conservancy District. The Conservancy District oversees the delivery of water for agricultural, municipal, and industrial uses to almost 1.5 million acres of northeastern Colorado. The map below shows the location of some of the reservoirs and canals used by the Conservancy District to deliver C-BT water to the Front Range. Additional information about the Conservancy District can be found at **www.ncwcd.org**.



Source Water Assessment Report

Our Water Source(s)
The system's sources of water are listed below.

Source	Water Type
Horsetooth Reservoir	*Surface*
Poudre River (seasonal)	*Surface*

The Tri-Districts (North Weld County Water District, East Larimer County Water District, and Fort Collins-Loveland Water District) drinking water comes from the Cache la Poudre River and Colorado-Big Thompson (C-BT) watersheds. The Tri-Districts have collaborated with other drinking water providers to develop and implement water quality monitoring programs for Horsetooth Reservoir and the upper Cache la Poudre Watershed. We are also a member of the Big Thompson Watershed Forum (www.btwatershed.org) and partner with other organizations regionally to monitor and analyze water quality in the C-BT watershed. Monitoring data is used to trend water quality changes in our watersheds over time.

The Colorado Department of Public Health and Environment has provided us with a Source Water Assessment Report for our water supply. You may obtain a copy of the report by visiting www.cdphe.state.co.us/wq/sw/swaphom.html (select Assessment Phase, Assessment Reports, Larimer, Soldier Canyon FP) or by contacting the treatment facility at (970) 482-3143. For questions regarding information in the report, please contact The SWAP Program at (303) 692-3592.

It is important to note that the data in the SWAP report was collected and ranked by the Colorado Department of Health and Environment, not by your water utility. It is also important to note that the susceptibility assessment ranking of your system as identified in the report is NOT a reflection of the quality of the treated drinking water that is supplied to you.

Potential sources of contamination in our source water area (as listed in the SWAP report) may come from:
Discrete sites including wastewater discharge sites, above ground, underground, and leaking storage tanks, solid waste sites, and existing/abandoned mine sites. Most of the discrete sites have a low to moderately low individual susceptibility. Dispersed sources include land use/cover types such as commercial/industrial/transportation, low intensity residential, grasses, crops, pastures, and forests. Other dispersed sources include septic systems, oil/gas wells, and roads. All of the dispersed sources have a low or moderately low individual susceptibility rating. Our overall vulnerability rating is low.

The Source Water Assessment Report provides a screening-level evaluation of potential contamination that could occur. It does not mean that the contamination has or will occur. We can use this information to evaluate the need to improve our current water treatment capabilities and prepare for future contamination threats. This can help us ensure that quality finished water is delivered to your homes. In addition, the source water assessment results provide a starting point for developing a source water protection plan.

Please contact the treatment facility at (970) 482-3143 to learn more about your drinking water sources, the treatment process, or water quality. We want you, our valued customers, to be informed about the services we provide and the quality water we deliver to you every day.

If we used purchased water, this report is required to include water quality data for the purchased water with this report.

How is ELCO's water treated?

Water delivered to the Soldier Canyon Filter Plant must go through several stages of treatment before it is delivered to ELCO customers. Since the water surface of Horsetooth is normally 200 feet higher than the treatment plant, raw water must first go through a control valve that reduces the water pressure. Some of the high-pressure water is diverted around the control valve to help in mixing chemicals that are added in the next step of the treatment process. Oxidizers and coagulants are mixed with the water to help during **flocculation**. The chemicals help create tiny, sticky clumps of floc that capture dirt and debris floating in the water. The floc grows larger as it passes through the flocculation basins on its way to the next step of the treatment process called sedimentation.

By the time the water reaches the **sedimentation** stage of treatment, floc in the water is heavy enough to sink to the bottom of the sedimentation basins. The settled floc is removed from the bottom of the sedimentation basins while the clear water above the settled floc is diverted for filtration. During **filtration**, water passes through layers of anthracite coal, sand and gravel to remove any remaining impurities. Additional chemicals are added to help stabilize the treated water. **Stabilization** is necessary to reduce the corrosiveness of water supplied to District customers. Finally, small amounts of chlorine and fluoride are added to the water. Chlorine kills any bacteria that may still be in the water. Fluoride helps reduce tooth decay.

What contaminants might be in drinking water?

The sources of drinking water (both tap water and bottled water) include rivers, lakes, streams, ponds, reservoirs, springs, and wells. As water travels over the surface of the land or through the ground, it dissolves naturally occurring minerals and, in some cases, radioactive material. All sources of drinking water are subject to contamination resulting from the presence of animals or from human activity.

Contaminants that may be present in source water include:

Microbial contaminants such as viruses and bacteria, which may come from sewage treatment plants, septic systems, agricultural livestock operations, and wildlife.

Inorganic contaminants such as salts and metals, which can be naturally-occurring or result from urban stormwater runoff, industrial, or domestic wastewater discharges, oil and gas production, mining, or farming.

Pesticides and herbicides which may come from a variety of sources such as agricultural, urban stormwater runoff, and residential uses.

Organic chemical contaminants including synthetic and volatile organic chemicals which are by-products of industrial processes and petroleum production, and can also come from gas stations, urban stormwater runoff, and septic systems.

Radioactive contaminants which can be naturally occurring or be the result of oil and gas production and mining activities.

In order to ensure that tap water is safe to drink, EPA prescribes regulations which limit the amount of certain contaminants in water provided by public water systems. The U.S. Food and Drug Administration (FDA) regulations establish limits for contaminants in bottled water that must provide the same protection for public health.

Have contaminants been found in ELCO's water?

Tests performed during the past year at Soldier Canyon Filter Plant and within the ELCO Water District distribution system show that drinking water supplied to ELCO customers meets all federal and state drinking water standards. Every regulated substance detected in ELCO's water was well below regulatory levels and goals established for public health.

Is ELCO's water safe for everyone?

All drinking water, including bottled water, may reasonably be expected to contain at least small amounts of some contaminants. The presence of contaminants does not necessarily indicate that the water poses a health risk. Some people may be more vulnerable to contaminants in drinking water than the general population. Immuno-compromised persons such as persons with cancer undergoing chemotherapy, persons who have undergone organ transplants, people with HIV-AIDS or other immune system disorders and some elderly, and infants can be particularly at risk of infections. These people should seek advice about drinking water from their health care providers.

Nitrate in drinking water at levels above 10 ppm is a health risk for infants of less than six months of age. High nitrate levels in drinking water can cause blue baby syndrome. Nitrate levels may rise quickly for short periods-of-time because of rainfall or agricultural activity. If you are caring for an infant, and detected nitrate levels are above 5 ppm, you should ask advice from your health care provider.

If **arsenic** is less than the MCL, your drinking water meets EPA's standards. EPA's standard balances the current understanding of arsenic's possible health effects against the costs of removing arsenic from drinking water. EPA continues to research the health effects of low levels of arsenic, which is a mineral known to cause cancer in humans at high concentrations and is linked to other health effects such as skin damage and circulatory problems.

Infants and young children are typically more vulnerable to **lead** in drinking water than the general population. It is possible that lead levels at your home may be higher than at other homes in the community as a result of materials used in your home's plumbing. If you are concerned about elevated lead levels in your home's water, you may wish to have your water tested. Flush your tap for 30 seconds to 2 minutes before using tap water. Additional information is available from the EPA Safe Drinking Water Hotline at 1-800-426-4791.

Is ELCO water hard or soft?

Many industrial and domestic water users are concerned about the hardness of their water. Manufacturers of dishwashers and washing machines sometimes recommend settings that depend on the hardness of water. Hard water requires more soap and synthetic detergents for home laundry and washing, and contributes to scaling in boilers and industrial equipment. Calcium and magnesium dissolved in water are the two most common minerals that make water "hard".

The hardness of water is referred to by three types of measurements: grains per gallon, milligrams per liter (mg/l), or parts per million (ppm). The water supplied by ELCO has a hardness of approximately 35 mg/l or 2 grains per gallon. The following table shows that ELCO water would be classified as "soft water".

Water Hardness Scale		
Grains per Gallon	**Milligrams per Liter (mg/l)**	**Classification**
0-4.3	0-75	Soft Water
4.3-8.8	75-150	Moderately Hard
8.8-17.50	150-300	Hard Water
Over 17.50	Over 300	Very Hard Water

Is there fluoride or chlorine in ELCO's water?

Small amounts of chlorine and fluoride are added to the water as it leaves the Soldier Canyon Filter Plant. Chlorine is added to disinfect the water against any bacteria that may still be in the water. Fluoride is added to help reduce tooth decay.

What if I have questions about my water?

If you have any questions about information contained in this report or the services provided by ELCO Water District, please contact Mike Scheid, ELCO's General Manager, at 970-493-2044. You are also invited to attend any regularly scheduled meeting of the District Board. Directors hold their meetings at 5:30 p.m. on the third Tuesday of each month at the offices of ELCO Water District, 232 South Link Lane.

2010 Water Quality Test Results for ELCO Water District

The following table shows the results of water quality analyses performed on water supplied by ELCO Water District. Every regulated substance detected in the water, even in the most minute amounts, is listed.

The table contains the name of each detected regulated substance, the highest level allowed (MCL), the ideal goals for public health (MCLG), the amount and/or range of amounts detected, the usual sources of such substances and an explanation of the units of measurement. Results are from monitoring performed for the period of January 1 to December 31, 2010 unless otherwise noted. **If a contaminant is not listed below then it has not been detected.**

The state requires monitoring for certain contaminants less than once per year because the concentrations of these contaminants are not expected to vary significantly from year to year, or the system is not considered vulnerable to this type of contamination. Some data, though representative, may be more than one year old.

Water Quality Test Results

Microbiological Contaminants

Contaminant	MCL	MCLG	Unit	Result	Violation	Sample Date	Likely Source of Contamination
Total Coliform Bacteria	**System collects>40 samples:** No more than 5% of monthly samples can be positive **System collects<40 samples:** No more than 1 positive monthly sample	0	Absent or Present	Absent	No	Monthly	Naturally present in the environment. Used as an indicator that other, potentially harmful bacteria may be present.
Fecal Coliform and E. Coli	A routine sample & a repeat sample are total coliform positive, & one is also fecal coliform or *E. coli positive.*	0	Absent or Present	Absent	No	Monthly	Human and animal fecal waste.

Turbidity

Contaminant	TT Requirement	Level Found	Violation (Yes or No)	Sample Date	Likely Source of Contamination
Turbidity	Maximum 1.0 NTU for any single measurement	Highest single measurement 0.043	No	Date: 11/15/10	Soil Runoff. Measures the clarity of the water. Turbidity is a good indicator of the effectiveness of the filtration system.
	In any month, at least 95% of samples must be less than 0.3 NTU	Lowest monthly percentage of samples meeting TT standard for our technology: 100%	No	Month:N/A	

Lead and Copper

Contaminant	AL	ALG	Units	90th Percentile	Number of Sites over AL	Violation (Yes or No)	Sample Date/Year	Likely Source of Contamination
Copper	1.3	1.3	ppm	0.178	0	No	06/09	Corrosion of household plumbing systems, erosion of natural deposits; leaching from wood preservatives
Lead	15	0	ppb	3.7	0	No	06/09	Corrosion of household plumbing systems, erosion of natural deposits

Disinfectants

Contaminant	MRDL	MRDLG	Units	Level Detected & Range		Violation (Yes or No)	Sample Date/Year	Source
Chlorine	4	4	ppm	0.4	0.1-0.07	No	Monthly	Water additive used to control microbes
Chlorine dioxide	0.8	0.8	ppm	0.0	0.0-0.06	No	Daily 2010	Water additive used to control microbes

Disinfection Byproducts

Contaminant	MCL	MCLG	Units	Average	Range	Highest RAA	Violation (Yes or No)	Sample Date/Year	Likely Source of Contamination
Haloacetic Acids (HAA5)	60	N/A	ppb	19.5	12.7-24.0	19.9	No	Quarterly 2010	By-product of drinking water disinfection
Total Trihalomethanes (TTHM)	80	N/A	ppb	38.5	29.9-48.4	38.5	No	Quarterly 2010	By-product of drinking water disinfection
Chlorite	1.0	0.8	ppm	0.29	0.15-0.58	0.44	No	Quarterly 2010	By-product of drinking water disinfection

Total Organic Carbon

Contaminant	Compliance Factor (measurements should not be lower than this factor)	Lowest Running Annual Average for the Year (compliance factor)	Running Annual Average Range for the Year (compliance factor)	Violation (Yes or No)	Sample Date/Year	Likely Source of Contamination
Total Organic Carbon (TOC)	1.0	1.22	1.28	No	Monthly 2010	Naturally Present in the environment

Inorganic Contaminants

Contaminant	MCL	MCLG	Units	Level Detected	Violation (Yes or No)	Sample Dates	Likely Source of Contamination
Barium	2	2	ppm	0.019	No	08/10/10	Discharge of drilling wastes; discharge from metal refineries; erosion of natural deposits
Fluoride	4	4	ppm	0.89	No	08/10/10	Erosion of natural deposits; water additive which promotes strong teeth; discharge from fertilizer and aluminum factories
Nitrate (as Nitrogen)	10	10	ppm	0.07	No	08/10/10	Runoff from fertilizer use; leaching from septic tanks, sewage; erosion of natural deposits
Selenium	0.05	0.05	ppm	0.0017	No	08/10/10	Discharge from petroleum and metal refineries; Erosion of natural deposits; Discharge from mines

Secondary Contaminants

Secondary standards are non-enforceable guidelines for contaminants that may cause cosmetic effects or aesthetic effects in drinking water. EPA recommends these standards but does not require water systems to comply.

Contaminant	Secondary Standard	MCLG	Units	Levels Detected	Violation (Yes or No)	Sample Dates	Likely Source of Contamination
Sodium	N/A	N/A	ppm	10.6	N/A	08/10/10	Runoff

Unregulated Contaminants

In 2009-2010, EPA required our system to monitor under the second cycle of the Unregulated Contaminant Monitoring Regulation (UCMR2). Our finished water was monitored quarterly for 10 contaminants that are not yet regulated. EPA plans to use this information for writing new regulations in the future. None of the contaminants were detected in our finished water.

Important Definitions

Parts per million (ppm) or Milligrams per liter (mg/L) - one part per million corresponds to one minute in two years or a single penny in $10,000.

Parts per billion (ppb) or Micrograms per liter (µg/L)- one part per billion corresponds to one minute in 2,000 years, or a single penny in $10,000,000.

Nephelometric Turbidity Unit (NTU) - nephelometric turbidity unit is a measure of the clarity of water. Turbidity in excess of 5 NTU is just noticeable to the average person.

Action Level (AL) - the concentration of a contaminant which, if exceeded, triggers treatment or other requirements which a water system must follow.

Action Level Goal (ALG) - The "Goal" is the level of a contaminant in drinking water below which there is no known or expected risk to health. The ALG allows for a margin of safety.

Treatment Technique (TT) - A treatment technique is a required process intended to reduce the level of a contaminant in drinking water.

Maximum Contaminant Level Goal (MCLG) - The "Goal" is the level of a contaminant in drinking water below which there is no known or expected risk to health. MCLGs allow for a margin of safety.

Maximum Contaminant Level (MCL)- The "Maximum Allowed" is the highest level of a contaminant that is allowed in drinking water. MCLs are set as close to the MCLGs as feasible using the best available treatment technology.

Maximum Residual Disinfectant Level Goal (MRDLG): The level of a drinking water disinfectant, below which there is no known or expected risk to health. MRDLGs do not reflect the benefits of the use of disinfectants to control microbial contaminants.

Maximum Residual Disinfectant Level (MRDL): The highest level of a disinfectant allowed in drinking water. There is convincing evidence that addition of a disinfectant is necessary for control of microbial contaminants.

Running Annual Average (RAA): An average of monitoring results for the previous 12 calendar months

2010 Town of Erie Water Quality & Consumer Confidence Report

COLORADO PUBLIC WATER SYSTEM IDENTIFICATION (PWSID) NUMBER : CO - 0162255

We are pleased to present to you the Annual Water Quality Report for the year 2010. This report is designed to provide our water customers with information about the quality water and services the Town of Erie delivers to you daily. Our constant goal is to provide you with a high quality supply of available drinking water at all times. The Town's water operators perform thousands of water tests each year to ensure quality drinking water. The Town staff also monitors drinking water according to federal and state laws for possible contaminants. We are proud that Erie meets and exceeds all federal and state drinking water standards. Erie continues to meet increasingly high water quality standards in a cost-effective manner for the citizens of Erie. If you have any questions regarding this report, please contact Jon Mays, Water & Wastewater Manager at 303-926-2895.

TOWN OF ERIE
1874

SOURCE WATER ASSESSMENT REPORT

The Colorado Department of Public Health & Environment (CDPHE) has provided a Source Water Assessment Report for our water supply. The Report is a starting point for the Source Water Assessment Plan being developed. It does not mean that contamination can or will occur. The report is a screening tool for the final plan. The full report can be found at: http://emaps.dphe.state.co.us/website/SWAP_Summary/Counties/Weld/162255-Erie_Town_of_SW.pdf or the Water Treatment Facility.

A summary of all potential sources of contamination for our source waters include: EPA Hazardous Waste Generators, Residential, Urban Recreational Grasses, EPA Chemical Inventory/Storage Sites, Agriculture, Permitted Wastewater Discharge Sites, Forest, Aboveground/Underground and Leaking Storage Tank Sites, Solid Waste Sites, Existing/Abandoned Mine, Septic Systems, Road Miles, Commercial/Industrial/Transportation, Oil/Gas Wells.

TREATMENT FACTS:

- In 2010, the Town produced 922 million gallons of water.
- The highest usage was 151 million gallons in August.
- The highest daily use was 6.3 million gallons in August.
- Erie has performed over 1,200 water tests at various locations throughout the Town.
- The maximum amount of water that can be produced is 12.2 million gallons per day.

PUBLIC PARTICIPATION OPPORTUNITIES:

Board of Trustees meetings are held the second and fourth Tuesday's of each month in the Board Room at Town Hall (645 Holbrook Street) at 6:30pm. Agendas are posted at Town Hall, Erie Post Office, and Town website at www.erieco.gov.

ERIE LAKE: Located at the northeast corner of State Highway 287 and Arapahoe Road.

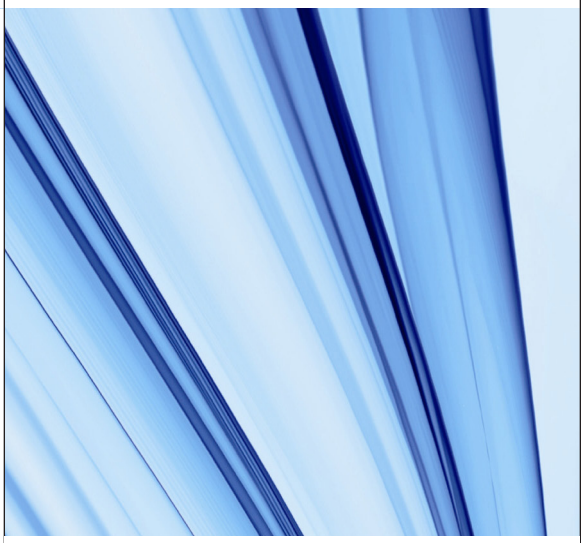
PROVIDING COMPREHENSIVE WATER CONSERVATION SOLUTIONS

WATER CONSERVATION PLAN

The Town of Erie adopted a Water Conservation Plan in 2008. This Plan evaluates Erie's water demands and supplies; defines water conservation goals; and evaluates conservation measures and programs for implementation. A copy may be downloaded from the Town's website at www.erieco.gov or hard copies are available for review in the Town Clerk's office at Town Hall (645 Holbrook Street).

IRRIGATION AUDIT KITS AVAILABLE

DPW has made an Irrigation Audit Kit available to residents. This kit helps residents adjust their landscape water consumption for optimal efficiency. The kit contains supplies and instructions to conduct a series of tests that measures the precipitation rate (how much water your irrigation system puts out), evaluate the evenness of the water application, a soil probe to check the soil type, and has charts to help determine the optimum watering times. Kits are available on a first-come, first-serve basis for Erie residents. For more information, contact the Public Works Department at 303-926-2870.



DEFINITIONS

- **Action Level (AL):** the Concentration of a contaminant, if exceeded, triggers treatment or other requirements a water system must follow.
- **Maximum contaminant level (MCL):** the highest level of a contaminant allowed in drinking water.
- **Maximum contaminant level goal (mclg):** the level of a contaminant in drinking water, below which there is no known or expected risk to health.
- **Maximum Residual Disinfectant Level (MRDL):** highest level of disinfectant allowed in drinking water.
- **Nephelometric Turbidity Unit (NTU):** nephelometric turbidity unit is a measure of the clarity of the water. Turbidity in excess of five NTU is just noticeable to the average person.
- **Parts per million (ppm) or milligrams per liter (mg/l):** one part substance per million parts water or the equivalent of one minute in two years.
- **Parts per billion (ppb) or micrograms per liter:** one part substance per billion parts water or one minute in 2,000 years
- **Parts per trillion (ppt) or Nanograms per liter (nanograms/L):** one part substance per trillion parts water or one minute in 2,000,000 years.
- **Running Annual Average- (RAA):** average of monitored results for the previous 12 calendar
- **Total Trihalomethanes:** sum of total concentrations of the individual Trihalomethanes.
- **Treatment Technique (TT):** a required process intended to reduce the level of a contaminant in drinking water.
- **Variance or exemptions:** permission to not meet an MCL, MRDL, AL or TT granted by the State or EPA.
- **Parts per million (ppm) or milligrams per liter (mg/l):** one part substance per million parts water or the equivalent of one minute in two years.

The State permits monitoring for some contaminants less than once per year because of the concentrations of these contaminants do not change frequently. Some of this data, though representative, is more than one year old. The "Range" column will show a single value for those contaminants that were sampled only once. NOTE: Only detected contaminants appear in this report.

Secondary standards are non-enforceable guidelines for contaminants that may cause cosmetic effects (such as tooth discoloration) or aesthetic effects (such as taste, odor, or color) in drinking water. EPA recommends these standards but does not require systems to comply.

Some people who drink water containing Trihalomethane in excess of the MCL over many years may experience problems with their liver, kidneys, or central nervous systems, and may have an increased risk of getting cancer. Infants less than 6 months who drink water containing nitrate in excess of MCL could become seriouly ill and if untreated, could die. Symptoms include shortness of breath and blue baby syndrome.

The Town of Erie does not operate under any variances or exemptions that are granted by state and federal agencies. However, the Town has been granted waivers for cyanide, dioxin, asbestos, glyphosphate, all unregulated inorganics, and all unregulated VOC's and SOC's.

PRINCE LAKE: Located at the southeast corner of State Highway 287 and Arapahoe Road.

The tables below show all detections between January 1 - December 31, 2010 unless otherwise noted.

MICROBIOLOGICAL CONTAMINENTS

Substance (units)	Collection Date	Level Detected	TT Requirements	Violation	Typical Source
Turbidity (NTU)	3/2010	Highest single measurement was 0.96	Max 1.0 NTU for single measurement or at least 95% of samples < 0.3 NTU	No	Soil runoff

INORGANIC CONTAMINENTS

Substance (unit)	Collection Date	Highest Value	Range	MCL	MCGL	Violation	Typical Source
Fluoride (ppm)	2010	1.6	0.6 - 1.6	4	4	No	Erosion of natural deposits; water additive which promotes strong teeth; discharge from fertilizr and aluminum factories/
Nitrate (ppm)	2010	0.024	0.024 - 0.024	10	10	No	Runoff from fertilizer use; leaching from septic tanks, sewage; erosion of natural deposits

Substance (units)	Collection Date	90th percentile	Action Level	Violation	Typical Source
Copper (ppm)	2008 - 2010	0.54	1.3	No	Corrosion of household plumbing systems; erosion of natural deposits
Lead (ppb)	2008 - 2010	8.7	0.15	No	Corrosion of household plumbing systems; erosion of natural deposits

VOLATILE ORGANIC CONTAMINENTS

Substance (unit)	Collection Date	Average	Range	# of Samples	MCL	MCGL	Violation	Typical Source
Haloacetic Acids [HAA5] (ppb)	2010	49.75	34.1 - 68.4	14	60	N/A	No	By-product of drinking water disinfection
TTHM [Total Trihalomethanes (ppb)	2010	46.88	27.8 - 64	14	80	N/A	No	By-product of drinking water chlorination

THOMAS RESERVOIR: Located at the southeast corner of 119th Street and Erie Parkway

WATER QUALITY INFORMATION

All drinking water, including bottled water, may reasonably be expected to contain at least small amounts of some contaminants. The presence of contaminants does not necessarily indicate that the water poses a health risk. Immuno-compromised persons such as persons with cancer undergoing chemotherapy, persons who have undergone organ transplants, people with HIV-AIDS or other immune system disorders, some elderly, and infants can be particularly at risk of infections. These people should seek advice about drinking water from their health care providers. For more information about contaminants and potential health effects, or to receive a copy of the US Environmental Protection Agency (EPA) and the US Centers for Disease Control (CDC) guidelines on appropriate means to lessen the risk of infection by cryptosporidium and microbiological contaminants call the EPA Safe Drinking Water Hotline at 1-800-426-4791.

The sources of drinking water, both tap water and bottled water, include rivers, lakes, streams, ponds, reservoirs, springs, and wells. As water travels over the surface of the land or through the ground, it dissolves naturally occurring minerals and, in some cases, radioactive material, and can pick up substances resulting from the presence of animals or from human activity. Contaminants that may be present in source water include:

- Microbial contaminants — such as viruses and bacteria that may come from wastewater treatment plants, septic systems, agricultural livestock operations, and wildlife.
- Inorganic contaminants — such as salts and metals, which can be naturally-occurring or result from urban storm water runoff, industrial or domestic wastewater discharges, oil and gas production, mining, or farming.
- Pesticides and herbicides — that may come from a variety of sources, such as agriculture, urban storm water runoff, and residential uses.
- Organic chemical contaminants — including synthetic and volatile organic chemicals, which are byproducts of industrial processes and petroleum production, and also may come from gas stations, urban storm water runoff, and septic systems.
- Radioactive contaminants — that can be naturally occurring or be the result of oil and gas production and mining activities.

In order to ensure that tap water is safe to drink, EPA prescribes regulations that limit the amount of certain contaminants in the water provided by public water systems. The Food and Drug Administration regulations establish limits for contaminants in bottled water that must provide the same protection for public health.

WATER SOURCES

The Town of Erie's water sources are Colorado-Big Thompson (C-BT) and South Boulder Creek (SBC). C-BT water is delivered via an underground pipeline from Carter Lake as well as down the Boulder Feeder Canal. SBC water is delivered via the South Boulder Canon Ditch. Once in Erie, water is delivered via pipeline directly to our WTF or it may be stored at either Erie Lake, Thomas Reservoir, or Prince Lake.

With the American Public Works Association (APWA) award winning plant, the Town can produce 12.2 million gallons per day (mgd) of treated water. The addition of submerged microfiltration membranes compliments the existing pressure membrane system and this expansion increased the firm capacity to 9.9 mgd, with a peak capacity of 12.15 MGD. A high service pump station distributes treated (potable) water to Town residents. Treated water is stored at our 1.5 mg storage tank to help ensure adequate delivery pressures and volumes.

The Colorado Department of Public Health and Environment (CDPHE) is the primary agency responsible for enforcing the Safe Drinking Water Act and National Primary Drinking Water Regulations in Colorado. In early 2007, the CDPHE conducted an extensive inspection of Erie's technologically advanced water treatment facility and found no deficiencies or violations. They recognized the water treatment staff with exceptional standard operating procedures that are in place as well as recognized the high quality of the facility's staff.

2901 N 119TH STREET, ERIE, COLORADO 80516 — 303.926.2860 t — 303.665.6544 f

Esta información es importante.
Si no la pueden leer, necesitan que alguien se la pueda traducir.

AWWA Standards

For over a century, AWWA has developed consensus standards for products used in the treatment and supply of potable water. Water professionals worldwide recognize AWWA Standards as the "Standard for Quality."

Downloadable!

If you need the most current AWWA standard right away, just download it at AWWA's download center—The Water Library.

www.waterlibrary.org

AWWA Standards Library Set

This is it. Your only source for the most complete and timely information on all of your waterworks products. To purchase individually at member price, you'd spend more than $5,300 to get all the standards. Get the complete set for just $1,895 member price ($3,445 retail), including free updates for a full year. That's an unbeatable value! Available in print or CD-ROM, the AWWA Standards collection puts more than 150 AWWA standards in 20 categories at your fingertips.

Print Standards

- Initial set purchase includes all current AWWA Standards plus one-year subscription to receive all new and revised standards issued in following 12 months (25–30 standards).
- Standards are hole-punched for insertion into AWWA Standards binders (included).

No. 49000 | Member $1,895 | Nonmember $3,445

CD-ROM Standards

- Initial CD-ROM purchase includes all current AWWA Standards plus one-year subscription to receive all new and revised standards issued in following 12 months (25–30 standards).
- Two CD-ROM updates issued per year.
- CD-ROM price determined by number of concurrent users.

Single user	**No. 40000**	Member $1,895	Nonmember $3,445
2 to 9 users	**No. 40001A**	Member $3,955	Nonmember $5,640
10 to 49 users	**No. 40001B**	Member $5,665	Nonmember $8,355
50 or more users	**No. 40001C**	Member $8,395	Nonmember $12,535

Look at what you get in your AWWA Standards Set:

- Complete set of AWWA Standards
- One-year AWWA Standards subscription
- Heavy-duty, post-type binders to hold all your AWWA Standards
- Plastic-laminated binder index tabs to keep your AWWA Standards organized
- *AWWA Standards at Work Every Day* video

- Groundwater and Wells
- Filtration
- Softening
- Disinfection Chemicals
- Coagulation
- Scale and Corrosion Control
- Taste and Odor Control
- Fluorides
- Ductile-Iron Pipe and Fittings
- Steel Pipe
- Concrete Pipe
- Valves and Hydrants
- Pipe Installation
- Disinfection of Facilities
- Meters
- Service Lines
- Plastic Pipe
- Storage
- Pumps
- Plant Equipment
- Utility Management

Standards subscription saves 70%

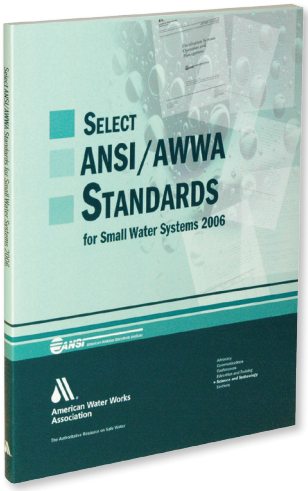
You save 70% with a subscription, compared to purchasing all revised standards separately. Plus, you are assured of having the most current AWWA Standards. Each year you will receive an invoice to continue your AWWA Standards subscription. Approximately 25 to 30 AWWA Standards are revised each year. Print and CD-ROM single-user renewal: $495 member, $995 nonmember. CD-ROM multi-user renewal prices are higher. Call AWWA Customer Service, 1.800.926.7337 or 303.794.7711, for price.

Standards Binder
Specially designed, vinyl-covered, post-type binders. Seven binders are needed to hold all AWWA Standards.

No. 49005 | Member $25 | Nonmember $38

Binder Index Tabs
Complete set of plastic laminated index tabs for AWWA Standards binders.

No. 47103 | Member Price $10.95 | Nonmember $16.95



Select ANSI/AWWA Standards for Small Systems

Can a small water system with a limited budget and few employees meet and even exceed the highest standards of water utility practice? The answer is yes—if you follow the specific recommendations of these five AWWA Standards specially selected as the most useful for water systems of 5,000 or fewer customers.

- A100 Standard for Water Wells
- B300 Standard for Hypochlorites
- C651 Standard for Disinfecting Water Mains
- C652 Standard for Disinfection of Water Storage Facilities
- G200 Standard for Distribution Systems Operation and Management

Bound into a handy book, these standards are indispensable for any small water system.

No. 20611 | Member $95 | Nonmember $143

DESIGNATION NAME		CAT. NO.	MEMBER	NONMEMBER
SOURCE				
Groundwater and Wells				
A100-06	Water Wells	41100	$49	$74
TREATMENT				
Filtration				
B100-01	Granular Filter Material	42100	$37	$56
B101-01	Precoat Filter Media	42101	$37	$56
B102-04	Manganese Greensand for Filters	42102	$37	$56
Softening				
B200-07	Sodium Chloride	42200	$37	$56
B201-08	Soda Ash	42201	$37	$56
B202-07	Quicklime and Hydrated Lime	42202	$37	$56
Disinfection Chemicals				
B300-04	Hypochlorites	42300	$37	$56
B301-04	Liquid Chlorine	42301	$37	$56
B302-05	Ammonium Sulfate	42302	$37	$56
B303-05	Sodium Chlorite	42303	$37	$56
B304-08	Liquid Oxygen for Ozone Generation for Water, Wastewater, and Reclaimed Water Systems	42304	$37	$56
B305-06	Anhydrous Ammonia	42305	$37	$56
B306-07	Aqua Ammonia (Liquid Ammonium Hydroxide)	42306	$37	$56
Coagulation				
B402-06	Ferrous Sulfate	42402	$37	$56
NEW B403-09	Aluminum Sulfate—Liquid, Ground, or Lump	42403	$37	$56
B404-08	Liquid Sodium Silicate	42404	$37	$56
B405-06	Sodium Aluminate	42405	$37	$56
B406-06	Ferric Sulfate	42406	$37	$56
B407-05	Liquid Ferric Chloride	42407	$37	$56

DESIGNATION NAME		CAT. NO.	MEMBER	NONMEMBER
TREATMENT				
Coagulation *(continued)*				
B408-03	Liquid Polyaluminum Chloride	42408	$37	$56
B451-04	Poly(Diallyldimethylammonium Chloride)	42451	$37	$56
B452-06	EPI-DMA Polyamines	42452	$37	$56
B453-06	Polyacrylamide	42453	$37	$56
Scale and Corrosion Control				
B501-08	Sodium Hydroxide (Caustic Soda)	42501	$37	$56
B502-05	Sodium Polyphosphate, Glassy (Sodium Hexametaphosphate)	42502	$37	$56
B503-05	Sodium Tripolyphosphate	42503	$37	$56
B504-05	Monosodium Phosphate, Anhydrous	42504	$37	$56
B505-05	Disodium Phosphate, Anhydrous	42505	$37	$56
B506-06	Zinc Orthophosphate	42506	$37	$56
B510-06	Carbon Dioxide	42510	$37	$56
B511-05	Potassium Hydroxide	42511	$37	$56
B512-08	Sulfur Dioxide	42512	$37	$56
B550-05	Calcium Chloride	42550	$37	$56
Taste and Odor Control				
B600-05	Powdered Activated Carbon	42600	$37	$56
B601-05	Sodium Metabisulfite	42601	$37	$56
B602-08	Copper Sulfate	42602	$37	$56
B603-03	Permanganates	42603	$37	$56
B604-05	Granular Activated Carbon	42604	$37	$56
B605-07	Reactivation of Granular Activated Carbon	42605	$37	$56
Fluorides				
B701-06	Sodium Fluoride	42701	$37	$56
B702-06	Sodium Fluorosilicate	42702	$37	$56
B703-06	Fluorosilicic Acid	42703	$37	$56
PIPE AND ACCESSORIES				
Ductile-Iron Pipe and Fittings				
C104/A21.4-08	Cement–Mortar Lining for Ductile-Iron Pipe and Fittings	43104	$43	$65
C105/A21.5-05	Polyethylene Encasement for Ductile-Iron Pipe Systems	43105	$43	$65
C110/A21.10-08	Ductile-Iron and Gray-Iron Fittings	43110	$49	$74
C111/A21.11-07	Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings	43111	$43	$65
C115/A21.15-05	Flanged Ductile-Iron Pipe With Ductile-Iron or Gray-Iron Threaded Flanges	43115	$43	$65
NEW C116/A21.16-09	Protective Fusion-Bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile-Iron and Gray-Iron Fittings	43116	$43	$65
C150/A21.50-08	Thickness Design of Ductile-Iron Pipe	43150	$43	$65
NEW C151/A21.51-09	Ductile-Iron Pipe, Centrifugally Cast	43151	$43	$65
C153/A21.53-06	Ductile-Iron Compact Fittings for Water Service	43153	$43	$65
Steel Pipe				
C200-05	Steel Water Pipe—6 In. (150 mm) and Larger	43200	$43	$65
NEW C203-08	Coal-Tar Protective Coatings and Linings for Steel Water Pipelines—Enamel and Tape—Hot-Applied	43203	$43	$65
C205-07	Cement–Mortar Protective Lining and Coating for Steel Water Pipe—4 In. (100 mm) and Larger—Shop Applied	43205	$43	$65
C206-03	Field Welding of Steel Water Pipe	43206	$43	$65
C207-07	Steel Pipe Flanges for Waterworks Service—Sizes 4 In. Through 144 In. (100 mm Through 3,600 mm)	43207	$43	$65
C208-07	Dimensions for Fabricated Steel Water Pipe Fittings	43208	$43	$65

DESIGNATION NAME		CAT. NO.	MEMBER	NONMEMBER
PIPE AND ACCESSORIES *(continued)*				
Steel Pipe *(continued)*				
C209-06	Cold-Applied Tape Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines	43209	$43	$65
C210-07	Liquid-Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines	43210	$43	$65
C213-07	Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines	43213	$43	$65
C214-07	Tape Coating Systems for the Exterior of Steel Water Pipelines	43214	$43	$65
C215-04	Extruded Polyolefin Coatings for the Exterior of Steel Water Pipelines	43215	$43	$65
C216-07	Heat-Shrinkable Cross-Linked Polyolefin Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines	43216	$43	$65
NEW C217-09	Petrolatum and Petroleum Wax Tape Coatings for the Exterior of Connections and Fittings for Steel Water Pipelines	43217	$43	$65
C218-08	Liquid Coating Systems for the Exterior of Aboveground Steel Water Pipelines and Fittings	43218	$43	$65
C219-06	Bolted, Sleeve-Type Couplings for Plain-End Pipe	43219	$43	$65
C220-07	Stainless-Steel Pipe, ½ In. (13 mm) and Larger	43220	$43	$65
C221-07	Fabricated Steel Mechanical Slip-Type Expansion Joints	43221	$43	$65
C222-08	Polyurethane Coatings for the Interior and Exterior of Steel Water Pipe and Fittings	43222	$43	$65
C223-07	Fabricated Steel and Stainless Steel Tapping Sleeves	43223	$43	$65
C224-06	Nylon-11-Based Polyamide Coating System for the Interior and Exterior of Steel Water Pipe, Connections, Fittings, and Special Sections	43224	$43	$65
C225-07	Fused Polyolefin Coating Systems for the Exterior of Steel Water Pipelines	43225	$43	$65
C226-06	Stainless-Steel Fittings for Waterworks Service, Sizes ½ In. Through 72 In. (13 mm Through 1,800 mm)	43226	$43	$65
C227-07	Bolted, Split-Sleeve Restrained and Nonrestrained Couplings for Plain-End Pipe	43227	$43	$65
C228-08	Stainless-Steel Pipe Flanges for Water Service—Sizes 2 In. Through 72 In. (50 mm Through 1,800 mm)	43228	$49	$74
C229-08	Fusion-Bonded Polyethylene Coating for the Exterior of Steel Water Pipelines	43229	$43	$65
Concrete Pipe				
C300-04	Reinforced Concrete Pressure Pipe, Steel-Cylinder Type	43300	$43	$65
C301-07	Prestressed Concrete Pressure Pipe, Steel-Cylinder Type	43301	$43	$65
C302-04	Reinforced Concrete Pressure Pipe, Noncylinder Type	43302	$43	$65
NEW C303-08	Concrete Pressure Pipe, Bar-Wrapped, Steel-Cylinder Type	43303	$43	$65
C304-07	Design of Prestressed Concrete Cylinder Pipe	43304	$49	$74
Valves and Hydrants				
NEW C500-09	Metal-Seated Gate Valves for Water Supply Service	43500	$43	$65
C502-05	Dry-Barrel Fire Hydrants	43502	$43	$65
C503-05	Wet-Barrel Fire Hydrants	43503	$43	$65
C504-06	Rubber-Seated Butterfly Valves	43504	$43	$65
C507-05	Ball Valves, 6 In. Through 48 In. (150 mm Through 1,200 mm)	43507	$43	$65
NEW C508-09	Swing-Check Valves for Waterworks Service, 2-In. Through 24-In. (50-mm Through 600-mm) NPS	43508	$43	$65
NEW C509-09	Resilient-Seated Gate Valves for Water Supply Service	43509	$43	$65
C510-07	Double Check Valve Backflow Prevention Assembly	43510	$43	$65
C511-07	Reduced-Pressure Principle Backflow Prevention Assembly	43511	$43	$65
C512-07	Air-Release, Air/Vacuum, and Combination Air Valves for Waterworks Service	43512	$43	$65
C513-05	Open-Channel, Fabricated-Metal Slide Gates and Open-Channel, Fabricated-Metal Weir Gates	43513	$43	$65
NEW C515-09	Reduced-Wall, Resilient-Seated Gate Valves for Water Supply Service	43515	$43	$65

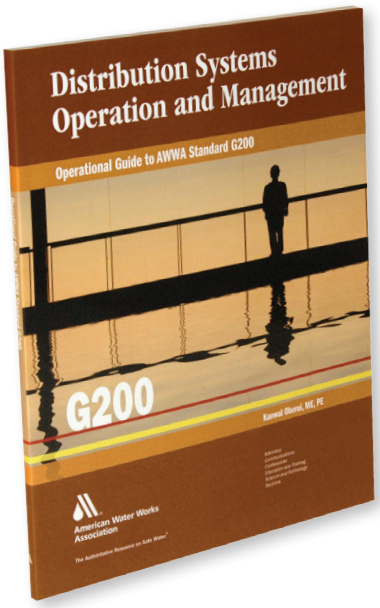
AWWA Standards

DESIGNATION	NAME	CAT. NO.	MEMBER	NONMEMBER
PIPE AND ACCESSORIES *(continued)*				
Valves and Hydrants *(continued)*				
C517-05	Resilient-Seated Cast-Iron Eccentric Plug Valves	43517	$43	$65
C518-08	Dual-Disc Swing-Check Valves for Waterworks Service	43518	$43	$65
C530-07	Pilot-Operated Control Valves	43530	$43	$65
NEW C541-08	Hydraulic and Pneumatic Cylinder and Vane-Type Actuators for Valves and Slide Gates	43541	$43	$65
NEW C542-09	Electric Motor Actuators for Valves and Slide Gates	43542	$43	$65
C550-05	Protective Interior Coatings for Valves and Hydrants	43550	$43	$65
C560-07	Cast-Iron Slide Gates	43560	$43	$65
C561-04	Fabricated Stainless Steel Slide Gates	43561	$43	$65
C563-04	Fabricated Composite Slide Gates	43563	$43	$65
PIPE INSTALLATION				
C600-05	Installation of Ductile-Iron Water Mains and Their Appurtenances	43600	$43	$65
C602-06	Cement–Mortar Lining of Water Pipelines in Place—4 In. (100 mm) and Larger	43602	$43	$65
C604-06	Installation of Steel Water Pipe—4 In. (100 mm) and Larger	43604	$43	$65
C605-05	Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water	43605	$43	$65
C606-06	Grooved and Shouldered Joints	43606	$43	$65
C620-07	Spray-Applied In-Place Epoxy Lining of Water Pipelines, 3 In. (75 mm) and Larger	43620	$43	$65
DISINFECTION OF FACILITIES				
C651-05	Disinfecting Water Mains	43651	$43	$65
C652-02	Disinfection of Water-Storage Facilities	43652	$43	$65
C653-03	Disinfection of Water Treatment Plants	43653	$43	$65
C654-03	Disinfection of Wells	43654	$43	$65
METERS				
NEW C700-09	Cold-Water Meters—Displacement Type, Bronze Main Case	43700	$43	$65
C701-07	Cold-Water Meters—Turbine Type, for Customer Service	43701	$43	$65
C702-01	Cold-Water Meters—Compound Type	43702	$43	$65
C703-96 (R04)	Cold-Water Meters—Fire-Service Type	43703	$43	$65
C704-08	Propeller-Type Meters for Waterworks Applications	43704	$43	$65
C706-96 (R05)	Direct-Reading, Remote-Registration Systems for Cold-Water Meters	43706	$43	$65
C707-05	Encoder-Type Remote-Registration Systems for Cold-Water Meters	43707	$43	$65
C708-05	Cold-Water Meters—Multijet Type	43708	$43	$65
NEW C710-09	Cold-Water Meters—Displacement Type, Plastic Main Case	43710	$43	$65
C712-02	Cold-Water Meters—Singlejet Type	43712	$43	$65
C713-05	Cold-Water Meters—Fluidic-Oscillator Type	43713	$43	$65
C750-03	Transit-Time Flowmeters in Full Closed Conduits	43750	$43	$65
SERVICE LINES				
C800-05	Underground Service Line Valves and Fittings	43800	$43	$65
PLASTIC PIPE				
C900-07	Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 12 In. (100 mm Through 300 mm), for Water Transmission and Distribution	43900	$43	$65
C901-08	Polyethylene (PE) Pressure Pipe and Tubing, ½ In. (13 mm) Through 3 In. (76 mm), for Water Service	43901	$43	$65
C903-05	Polyethylene—Aluminum—Polyethylene & Cross-linked Polyethylene—Aluminum—Cross-linked Polyethylene Composite Pressure Pipes, ½ In. (12 mm) Through 2 In. (50 mm), for Water Service	43903	$43	$65
C904-06	Cross-Linked Polyethylene (PEX) Pressure Pipe, ½ In. (12 mm) Through 3 In. (76 mm), for Water Service	43904	$43	$65

DESIGNATION	NAME	CAT. NO.	MEMBER	NONMEMBER
PLASTIC PIPE *(continued)*				
C905-97	Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14 In. Through 48 In. (350 mm Through 1,200 mm), for Water Transmission and Distribution	43905	$43	$65
C906-07	Polyethylene (PE) Pressure Pipe and Fittings, 4 In. (100 mm) Through 63 In. (1,600 mm), for Water Distribution and Transmission	43906	$43	$65
C907-04	Injection-Molded Polyvinyl Chloride (PVC) Pressure Fittings, 4 In. Through 12 In. (100 mm Through 300 mm), for Water Distribution	43907	$43	$65
C909-02	Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe, 4 In. Through 24 In. (100 mm Through 600 mm), for Water Distribution	43909	$43	$65
C950-07	Fiberglass Pressure Pipe	43950	$43	$65
STORAGE				
D100-05	Welded Carbon Steel Tanks for Water Storage	44100	$49	$74
D102-06	Coating Steel Water-Storage Tanks	44102	$43	$65
NEW D103-09	Factory-Coated Bolted Carbon Steel Tanks for Water Storage	44103	$49	$74
D104-04	Automatically Controlled, Impressed-Current Cathodic Protection for the Interior of Steel Water Tanks	44104	$43	$65
D110-04	Wire- and Strand-Wound, Circular, Prestressed Concrete Water Tanks	44110	$49	$74
D115-06	Tendon-Prestressed Concrete Water Tanks	44115	$49	$74
NEW D120-09	Thermosetting Fiberglass-Reinforced Plastic Tanks	44120	$43	$65
D130-02	Flexible-Membrane Materials for Potable Water Applications	44130	$43	$65
PUMPS				
E102-06	Submersible Vertical Turbine Pumps	45102	$49	$74
E103-07	Horizontal and Vertical Line-Shaft Pumps	45103	$49	$74
PLANT EQUIPMENT				
F101-07	Contact-Molded, Fiberglass-Reinforced Plastic Wash-Water Troughs and Launders	46101	$43	$65
F102-07	Matched-Die-Molded, Fiberglass-Reinforced Plastic Weir Plates, Scum Baffles, and Mounting Brackets	46102	$43	$65
UTILITY MANAGEMENT				
G100-05	Water Treatment Plant Operation and Management	47100	$37	$56
G200-04	Distribution Systems Operation and Management	47200	$37	$56
G300-07	Source Water Protection	47300	$37	$56
G400-09	Utility Management System	47400	$37	$56
NEW G410-09	Business Practices for Operation and Management	47410	$43	$65
G430-09	Security Practices for Operation and Management	47430	$37	$56

consensus reviewed

AWWA Standards are carefully reviewed consensus documents. Each Standard is developed and approved by a committee of recognized experts in the subject matter covered and reflect accepted industry best practices.



New!

Operational Guide to AWWA Standard G200, Distribution Systems Operation and Management

Kanwal Oberoi, ME, PE

This is an operational guidance document for the implementation of water distribution systems operation and management best practices, as set forth in ANSI/AWWA G200 Distribution Systems Operations and Management (AWWA G200). AWWA G200 is one of the new G-series standards for water utility management, initially established in 2004. The operational guide will help utility managers understand the purpose and function of this new standard and help them implement and incorporate the standard into everyday operations. The book includes practical examples, checklists, and questions to ask that help a utility monitor its progress in maximizing distribution system performance.

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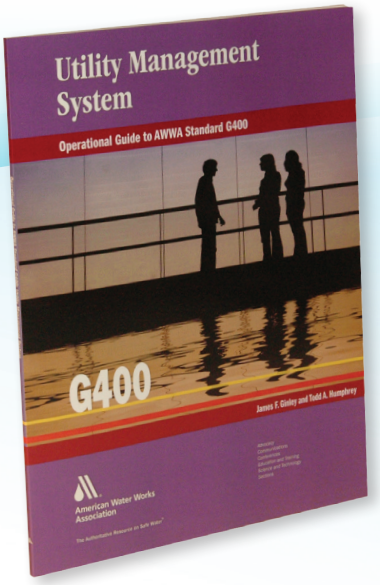

New!

Operational Guide to AWWA Standard G400, Utility Management System

James F. Ginley and Todd A. Humphrey

This is an operational guidance document for the implementation of utility management best practices, as set forth in ANSI/AWWA G400 Utility Management System (AWWA G400). AWWA G400 is one of the new G-series standards for water utility management, initially established in 2004. The operational guide will help utility managers understand the purpose and function of the new standard and help them implement and incorporate the standards into everyday operations. The book includes practical examples, checklists, and questions to ask that help a utility monitor its progress in implementing management best practices.

Published by AWWA, 2009, softbound, 96 pp. ISBN 978-1-58321-733-7

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Fact Sheet: Stage 2 Disinfectants and Disinfection Byproducts Rule

In the past 30 years, the Safe Drinking Water Act (SDWA) has been highly effective in protecting public health and has also evolved to respond to new and emerging threats to safe drinking water. Disinfection of drinking water is one of the major public health advances in the 20th century. One hundred years ago, typhoid and cholera epidemics were common through American cities; disinfection was a major factor in reducing these epidemics.

However, the disinfectants themselves can react with naturally-occurring materials in the water to form byproducts, which may pose health risks. In addition, in the past 10 years, we have learned that there are specific microbial pathogens, such as *Cryptosporidium*, which can cause illness, and are highly resistant to traditional disinfection practices.

Amendments to the SDWA in 1996 require EPA to develop rules to balance the risks between microbial pathogens and disinfection byproducts (DBPs). The Stage 1 Disinfectants and Disinfection Byproducts Rule and Interim Enhanced Surface Water Treatment Rule, promulgated in December 1998, were the first phase in a rulemaking strategy required by Congress as part of the 1996 Amendments to the Safe Drinking Water Act.

The Stage 2 Disinfectants and Disinfection Byproducts Rule (Stage 2 DBPR) builds upon the Stage 1 DBPR to address higher risk public water systems for protection measures beyond those required for existing regulations.

The Stage 2 DBPR and the Long Term 2 Enhanced Surface Water Treatment Rule are the second phase of rules required by Congress. These rules strengthen protection against microbial contaminants, especially *Cryptosporidium*, and at the same time, reduce potential health risks of DBPs.

Questions and Answers

What is the Stage 2 DBPR?

The Stage 2 Disinfection Byproducts Rule will reduce potential cancer and reproductive and developmental health risks from disinfection byproducts (DBPs) in drinking water, which form when disinfectants are used to control microbial pathogens. Over 260 million individuals are exposed to DBPs.

This final rule strengthens public health protection for customers by tightening compliance monitoring requirements for two groups of DBPs, trihalomethanes (TTHM) and haloacetic acids (HAA5). The rule targets systems with the greatest risk and builds incrementally on existing rules. This regulation will reduce DBP exposure and related potential health risks and provide more equitable public health protection.

The Stage 2 DBPR is being promulgated simultaneously with the Long Term 2 Enhanced Surface Water Treatment Rule to address concerns about risk tradeoffs between pathogens and DBPs.

What does the rule require?

Under the Stage 2 DBPR, systems will conduct an evaluation of their distribution systems, known as an Initial Distribution System Evaluation (IDSE), to identify the locations with high disinfection byproduct concentrations. These locations will then be used by the systems as the sampling sites for Stage 2 DBPR compliance monitoring.

Compliance with the maximum contaminant levels for two groups of disinfection byproducts (TTHM and HAA5) will be calculated for each monitoring location in the distribution system. This approach, referred to as the locational running annual average (LRAA), differs from current requirements, which determine compliance by calculating the running annual average of samples from all monitoring locations across the system.

The Stage 2 DBPR also requires each system to determine if they have exceeded an operational evaluation level, which is identified using their compliance monitoring results. The operational evaluation level provides an early warning of possible future MCL violations, which allows the system to take proactive steps to remain in compliance. A system that exceeds an operational evaluation level is required to review their operational practices and submit a report to their state that identifies actions that may be taken to mitigate future high DBP levels, particularly those that may jeopardize their compliance with the DBP MCLs.

Who must comply with the rule?

Entities potentially regulated by the Stage 2 DBPR are community and nontransient noncommunity water systems that produce and/or deliver water that is treated with a primary or residual disinfectant other than ultraviolet light.

A community water system (CWS) is a public water system that serves year-round residents of a community, subdivision, or mobile home park that has at least 15 service connections or an average of at least 25 residents.

A nontransient noncommunity water system (NTNCWS) is a water system that serves at least 25 of the same people more than six months of the year, but not as primary residence, such as schools, businesses, and day care facilities.

What are disinfection byproducts (DBPs)?

Disinfectants are an essential element of drinking water treatment because of the barrier they provide against waterborne disease-causing microorganisms. Disinfection byproducts (DBPs) form when disinfectants used to treat drinking water react with naturally occurring materials in the water (e.g., decomposing plant material).

Total trihalomethanes (TTHM - chloroform, bromoform, bromodichloromethane, and dibromochloromethane) and haloacetic acids (HAA5 - monochloro-, dichloro-, trichloro-, monobromo-, dibromo-) are widely occurring classes of DBPs formed during disinfection with chlorine and chloramine. The amount of trihalomethanes and haloacetic acids in drinking water can change from day to day, depending on the season, water temperature, amount of disinfectant added, the amount of plant material in the water, and a variety of other factors.

Are THMs and HAAs the only disinfection byproducts?

No. The four THMs (TTHM) and five HAAs (HAA5) measured and regulated in the Stage 2 DBPR act as indicators for DBP occurrence. There are many other known DBPs, in addition to the possibility of unidentified DBPs present in disinfected water. THMs and HAAs typically occur at higher levels than other known and unknown DBPs. The presence of TTHM and HAA5 is representative of the occurrence of many other chlorination DBPs; thus, a reduction in the TTHM and HAA5 generally indicates a reduction of DBPs from chlorination.

What are the costs and benefits of the rule?

Quantified benefits estimates for the Stage 2 DBPR are based on reductions in fatal and non-fatal bladder cancer cases. EPA has projected that the rule will prevent approximately 280 bladder cancer cases per year. Of these cases, 26% are estimated to be fatal. Based on bladder cancer alone, the rule is estimated to provide annualized monetized benefit of $763 million to $1.5 billion.

The rule applies to approximately 75,000 systems; a small subset of these (about 4%) will be required to make treatment changes. The mean cost of the rule is $79 million annually. Annual household cost increases in the subset of plants adding treatment are estimated at an average of $5.53, with 95 percent paying less than $22.40.

What are the compliance deadlines?

Compliance deadlines are based on the sizes of the public water systems (PWSs). Wholesale and consecutive systems of any size must comply with the requirements of the Stage 2 DBPR on the same schedule as required for the largest system in the combined distribution system (defined as the interconnected distribution system consisting of wholesale systems and consecutive systems that receive finished water). Compliance activities are outlined in the following table.

PUBLIC WATER SYSTEMS	ACTIONS			
	Submit IDSE monitoring plan, system specific study plan, or 40/30 certification	**Complete an initial distribution system evaluation (IDSE)**	**Submit IDSE Report**	**Begin subpart V (Stage 2) compliance monitoring**
CWSs and NTNCWSs serving at least 100,000	October 1, 2006	September 30, 2008	January 1, 2009	April 1, 2012
CWSs and NTNCWSs serving 50,000 - 99,999	April 1, 2007	March 31, 2009	July 1, 2009	October 1, 2012
CWSs and NTNCWSs serving 10,000 - 49,999	October 1, 2007	September 30, 2009	January 1, 2010	October 1, 2013
CWSs serving fewer than 10,000	April 1, 2008	March 31, 2010	July 1, 2010	October 1, 2013
NTNCWSs serving fewer than 10,000	NA	NA	NA	October 1, 2013

*States may grant up to an additional two years for systems making capital improvements.

What technical information will be available on the rule?

The following Guidance Documents will be available:

- Initial Distribution System Evaluation (IDSE) Guidance Manual
- Operational Evaluation Guidance Manual
- Consecutive Systems Guidance Manual
- Small Systems (SBREFA) Guidance Manual
- Simultaneous Compliance Guidance Manual

Where can I find more information about this notice and the Stage 2 DBPR?

For general information on the rule, please visit the EPA Safewater website at http://www.epa.gov/safewater/disinfection/stage2 or contact the Safe Drinking Water Hotline at 1-800-426-4791. The Safe Drinking Water Hotline is open Monday through Friday, excluding legal holidays, from 10:00 a.m. to 4:00 p.m., Eastern Time. For technical inquiries, email stage2mdbp@epa.gov.

Office of Water (4607M) EPA 815-F-05-003 December 2005 www.epa.gov/safewater