



**RADIOLOGICAL INVESTIGATION RESULTS FOR
PENNSYLVANIA LANDFILL LEACHATE:
2009 TRITIUM UPDATE**

March 31, 2010

Prepared for:
Environmental Research and Education Foundation

Project No. 130651

Prepared by:
**Safety and Ecology Corporation (SEC)
2800 Solway Road
Knoxville, TN 37931**

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ABBREVIATIONS, ACRONYMS, AND SYMBOLS

ARAR	Applicable or Relevant and Appropriate Requirement
BRP	Bureau of Radiation Protection
BSFR	Bulk Survey For Release
C/D	Construction/Demolition
CEDE	Committed Effective Dose Equivalent
CFR	Code of Federal Regulations
COC	Constituent of Concern
CWS	Community Water System
ID	Identification
EPA	U.S. Environmental Protection Agency
EREF	Environmental Research and Education Foundation
FGR	Federal Guidance Report
GTLS	Gaseous Tritium Light Source
HASP	Health and Safety Plan/Program
MCL	Maximum Contaminant Level
MDC	Minimum Detectable Concentration
MPC	Maximum Permissible Concentration
MSW	Municipal Solid Waste
NBS	National Bureau of Standards
NFPA	National Fire Protection Association
^{14}N	Nitrogen
NRC	Nuclear Regulatory Commission
PADEP	Pennsylvania Department of Environmental Protection
PSI	Product Stewardship Institute
QAP	Quality Assurance Program
QC	Quality Control
RW	Residual Waste
SAP	Sampling and Analysis Plan
SEC	Safety and Ecology Corporation
TDEC	Tennessee Division of Environmental Conservation
TEDE	Total Effective Dose Equivalent
^3H	Tritium
USEPA	U.S. Environmental Protection Agency

EXECUTIVE SUMMARY

In 2004 and 2005, the Pennsylvania Department of Environmental Protection (PADEP) identified the presence of tritium (^3H) in over 90% of the landfill leachate samples from 54 permitted landfills in Pennsylvania. While ^3H is produced naturally in the upper atmosphere by cosmic ray interaction with nitrogen (^{14}N) in air, it is also produced artificially during nuclear weapon production/use, as a byproduct in nuclear power production, and for other uses. It is these other uses that are most likely to be disposed of in municipal solid waste landfills, and most notable among these are gaseous tritium light source (GTLS) devices used as emergency 'EXIT' signs. Despite regulatory requirements, accidental disposal of GTLS devices in municipal solid waste landfills is not uncommon (PADEP 2005, 2006a). These exit signs typically contain 10-15 curies of tritium but some contain as much as 30 Curies, and they typically have usable life spans of 10-20 years due to the relatively short 12.32 year half life of tritium¹.

Tritium is not a treatable constituent in landfill leachate. Consequently, when evaluating the results of the two sampling events, PADEP properly recognized that it was necessary to consider appropriate dilution factors both through publicly owned treatment works and/or from the discharge structures to the nearest downstream drinking water intake. Based on the review of many factors including the concentrations of tritium observed, the location of treated liquid effluent discharge points, leachate discharge rates, dilution factors of receiving streams and distance to downstream water supply intakes PADEP converted the observed leachate tritium concentrations into diluted concentrations assumed to be available for human consumption at the closest drinking water supply downstream from the leachate discharge structure. PADEP performed this dilution analysis for each of the 54 landfills, and after applying the PADEP dilution factors, the resulting concentrations of ^3H were found to be well below not only the United States Environmental Protection Agency (USEPA) maximum contaminant level (MCL) of 20,000 pCi/L for ^3H for drinking water, but also well below 10% of that MCL. (PADEP 2006b).

In support of this preliminary work, the PADEP in cooperation with the solid waste industry, initiated a sampling study to evaluate fluctuations and trends in tritium levels. This report presents the results of the study and provides comparison to the preliminary studies performed. As part of this study, samples were collected from 54 active landfills over 8 consecutive calendar quarters from the 2nd quarter of 2007 through the 1st quarter of 2009. The leachate ^3H concentrations ranged from (-38) to 356,774 pCi/L, with a mean concentration of 38,091 pCi/L. Roughly 52% (216 out of 416) of the samples had concentrations >20,000 pCi/L.

Figure ES-1 shows average tritium concentrations in leachate collected from the 2nd quarter of 2007 through the 1st quarter of 2009 from the 54 active Pennsylvania landfills included in this study. The whisker plots show the maximum and minimum ^3H concentrations (end of whiskers) at each landfill, as well as the average (point) concentration for each landfill.

¹ <http://www.rila.org/news/newsletters/rilareportsustainability/Mar2009/Pages/HandlingTritiumExitSigns.aspx> (accessed July 23, 2009).

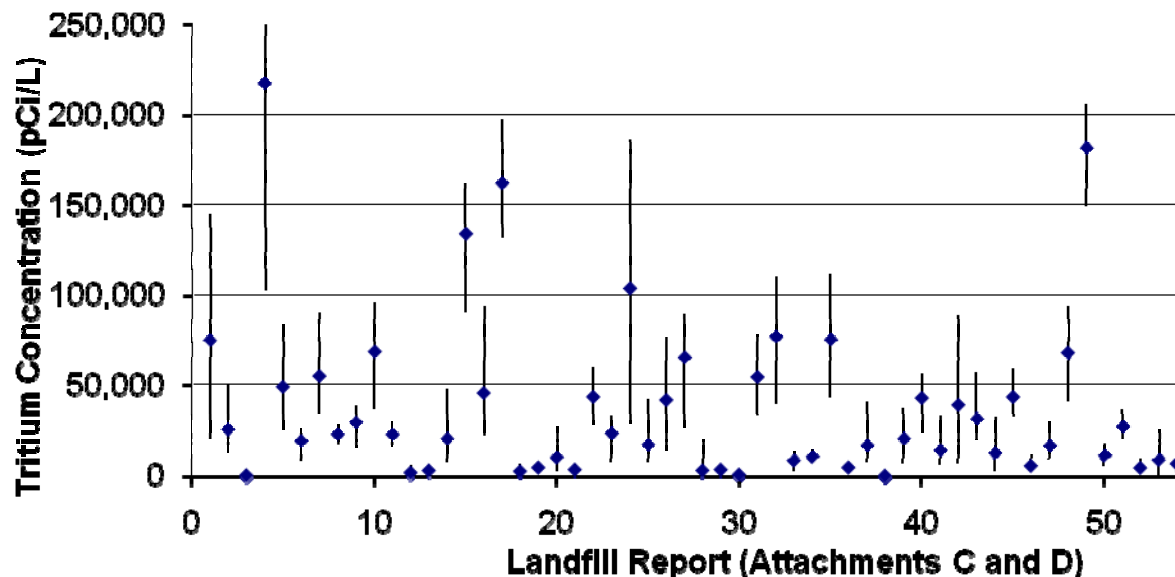


Figure ES-1. Measured Tritium Concentrations in Leachate Collected from Pennsylvania Landfills.

Figure ES-2 presents estimated diluted tritium concentrations for the same landfills at the nearest downstream drinking water intake based on dilution factors designated by the PADEP. These concentrations have been calculated by applying PADEP landfill-specific dilution factors available from the leachate discharge structure to the nearest downstream drinking water intake to each landfill. As shown in Figure ES-2, the ^3H activity concentrations at the nearest drinking water intake are 100 times less than the USEPA 20,000 pCi/L MCL.

NOTE: The landfills are presented in Figures ES-1 and ES-2 in alphabetical order consistent with the presentation of landfill data tables and individual landfill trend graphs in Attachments C, D, and E.

NOTE: The tritium activity concentration results in units of pCi/L are presented as reported with all figures reported (e.g., 23,411 pCi/L). The actual number of significant figures for analytical results is assumed to be three (e.g., 23,400 pCi/L).

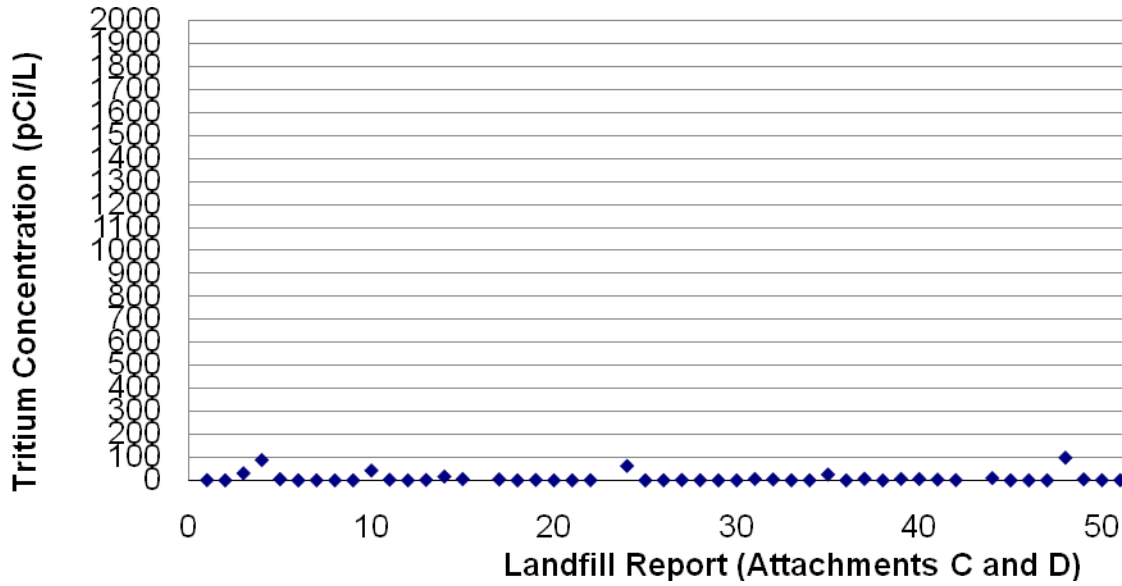


Figure ES-2. Diluted Tritium Results for Pennsylvania Landfills. Assumes dilution is computed based on the distance from the landfill to the nearest downstream drinking water intake and conservative stream/river flowrates.

NOTE: 2,000 pCi/L is 10% of the EPA 20,000 pCi/L MCL at a downstream drinking water intake.

1.0 INTRODUCTION

1.1 Scope

In 2004, on the heels of having adopted sweeping new radiation detection and prevention regulations for preventing radioactive waste coming into landfills, the Pennsylvania Department of Environmental Protection (PADEP) implemented a sampling and analysis plan (SAP) to investigate whether radioactive material was potentially present in untreated landfill leachate. The investigation included all active and permitted landfills in the Commonwealth of Pennsylvania having a leachate collection system (i.e., 54 solid waste landfills in the Commonwealth met this selection criterion). A report of this investigation was published in October 2005 (PADEP 2005). Prompted by these results, PADEP conducted a subsequent round of sampling in 2005 to analyze tritium (^3H) levels at the same landfills sampled in 2004. Sample results obtained in 2004 ranged from 7 to 93,500 pCi/L, with a mean concentration of 24,400 pCi/L. Roughly 52% (28 out of 54) of the samples had concentrations > 20,000 pCi/L. For the 2005 sampling event, results ranged from -62.1 to 181,700 pCi/L, with a mean concentration of 22,400 pCi/L. Approximately 30% (16 out of 54) of samples had concentrations > 20,000 pCi/L (PADEP 2005, 2006a).

Tritium is not a treatable constituent in landfill leachate. Consequently, when evaluating the results of the two sampling events, PADEP properly recognized that it was necessary to consider appropriate dilution factors both through publicly owned treatment works and/or from the discharge structures to the nearest downstream drinking water intake. Based on the review of many factors including the concentrations of tritium observed, the location of treated liquid effluent discharge points, leachate discharge rates, dilution factors of receiving streams and distance to downstream water supply intakes PADEP converted the observed leachate tritium concentrations into diluted concentrations assumed to be available for human consumption at the closest drinking water supply downstream from the leachate discharge structure. PADEP performed this dilution analysis for each of the 54 landfills, and after applying the PADEP dilution factors, the resulting concentrations of ^3H were found to be well below not only the United States Environmental Protection Agency (USEPA) maximum contaminant level (MCL) of 20,000 pCi/L for ^3H for drinking water, but also well below 10% of that MCL. (PADEP 2006b).

In support of this preliminary work, the PADEP in cooperation with the solid waste industry initiated a sampling study to evaluate fluctuations and trends in tritium levels in landfill leachate. To this end, the Environmental Research and Education Foundation (EREF), a non-profit grant making entity specifically focused on solid waste issues, provided funding to conduct ^3H monitoring of untreated landfill leachate at active Pennsylvania landfills for 8 consecutive calendar quarters (2nd quarter of 2007 through 1st quarter 2009). PADEP performed both the ^3H sampling and laboratory analysis. This report documents the results of this sampling effort and provides risk-based recommendations for future monitoring.

1.2 Background

Tritium (^3H) is produced naturally in the upper atmosphere by cosmic ray interaction with nitrogen (^{14}N) in air. Tritium is also produced artificially during nuclear weapon production/explosions, as a byproduct in nuclear power production, and for other uses. It is these other uses

that are most likely to be disposed of in municipal solid waste landfills. Low-level sources include emergency exit signs, compasses, watches, firearm sights, and even novelty items, such as “glow stick” key chains. Most notable among these low-level sources are gaseous tritium light source (GTLS) devices used as emergency ‘EXIT’ signs which satisfy the National Fire Protection Association (NFPA) Life Safety Code for illuminated exit markers. Despite regulatory requirements, accidental disposal of GTLS devices in municipal solid waste landfills is not uncommon (PADEP 2005, 2006a). These exit signs typically contain 10-15 curies of tritium but some contain as much as 30 curies, and they typically have usable life spans of 10-20 years due to the relatively short 12.32 year half life of tritium². Compasses, watches, rifle sights, and novelty items, such as “glow stick” key chains³ only contain from 0.001 to 0.1 curies of tritium (Semkow et al. 2002 and DOE 2002).

Manufacturers of GTLS devices used as emergency ‘EXIT’ signs are licensed under the Nuclear Regulatory Commission (NRC) and are required to make the user, or general licensee, aware that ownership of the devices may be transferred only to those persons specifically licensed to accept the material upon disposal. Several million GTLS exit signs have been registered in the United States and some tritium signs are not properly returned and recycled (USNRC 2009). Manufacturers often charge a fee to accept returned signs. These recycled exit signs are shipped to tritium tube manufacturing facilities outside the United States for recycling/disposal. It is suspected that a portion of these signs have ended up in the municipal solid waste or construction and demolition waste streams. For more information on the disused source problem, see the Product Stewardship Institutes’ (PSI) report.⁴

There are a total of 54 active solid waste landfills in Pennsylvania designated for receipt of municipal solid waste (MSW), residual waste (RW), and construction/demolition (C/D) debris. Each of these landfills is permitted by PADEP and are included in this sampling event. Most of the landfills feature a leachate collection system to capture liquids percolating through the waste material for treatment at a wastewater treatment facility. Active landfill operators are required by PADEP regulations to periodically sample and characterize their leachate for a suite of nonradioactive constituents of concern (COCs).

The active landfills sampled as part of this study are shown in Table 1-1. The SAP ID in Table 1-1 is based on the previous PADEP investigation numbering system which accounted for field duplicate samples taken. The Report ID is based on the original sample included in the present study.

1.3 Data Needs

The primary data requirement for fulfillment of the SAP was ³H radioactivity concentration. No secondary data needs were anticipated based on a review of the primary data.

² <http://www.rila.org/news/newsletters/rilareportsustainability/Mar2009/Pages/HandlingTritiumExitSigns.aspx> (Accessed July 23, 2009).

³ <http://www.ecofriend.org/entry/mini-tritium-glowring-keychain-lighting-up-without-a-source-for-good-10-years/>

⁴ <http://www.epa.gov/rpdweb00/docs/source-management/psi-radmat-bkgrd-rpt.pdf> (accessed July 23, 2009).

Table 1-1. Active Landfills Sampled for Tritium with Permit Number and Location (city, county)

	SAP ID	Facility Name and Report ID ()	Permit	City	County
Southeast Region	001-002	Bethlehem Steel Corp RWLF (3)	100020	Coatesville	Chester
	003-004	GROWS MWLF (17)	100148	Morrisville	Bucks
	005-006	Pottstown MWLF (41)	100549	Pottstown	Montgomery
	007-008	SECCRA MWLF (43)	101069	West Grove Kennett	Chester
	009-010	Tullytown Resource Recovery MWLF (49)	101494	Tullytown	Bucks
Northeast Region	011-012	Alliance Sanitary LF/MWLF (1)	100933	Taylor	Lackawanna
	013-014	Chrin Brothers Inc. MWLF (7)	100022	Easton	Northampton
	015-016	Commonwealth Environmental Systems MWLF (9)	101615	Foster Township Hegins	Schuylkill
	017-018	Grand Central Sanitary LF/MWLF (15)	100265	Pen Argyl	Northampton
	019-020	Bethlehem LF/MWLF (18)	100020	Bethlehem	Northampton
	021-022	Keystone Sanitary LF/MWLF (22)	101247	Dunmore	Lackawanna
	023-024	Pine Grove LF/MWLF (39)	101427	Pine Grove	Schuylkill
Southcentral Region	025-026	Cumberland County MWLF (10)	100945	Shippensburg / Newburg	Cumberland
	027-028	Conestoga MWLF (4)	101509	New Morgan	Berks
	029-030	Greater Lebanon Refuse Authority MWLF (14)	101544	Lebanon	Lebanon
	031-032	Blue Bridge MWLF (19)	100934	Scotland	Franklin
	033-034	LCSWMA Frey Farm MWLF (26)	101389	Conestoga	Lancaster
	035-036	Lanchester MWLF (24)	100944	Narvon	Lancaster
	037-038	Mifflin County SWA MWLF (30)	101165	Lewistown	Mifflin
Southcentral Region	039-040	Milton Grove C/DLF (31)	101559	Mt. Joy Township	Lancaster
	041-042	Modern MWLF (32)	100113	York	York
	043-044	Mountain View MWLF (35)	101100	Greencastle	Franklin
	045-046	Pioneer Crossing MWLF (40)	100346	Birdsboro / Harleysville	Berks
	047-048	Rolling Hills MWLF (11)	100345	Boyertown	Berks
	049-050	Sandy Run MWLF (42)	101538	Hopewell	Bedford
	051-052	Western Berks RA MWLF (52)	100739	Birdsboro	Berks

	SAP ID	Facility Name and Report ID ()	Permit	City	County
Northcentral Region	053-054	Allenwood MWLF (27)	100963	Brady Township	Lycoming
	055-056	Northern Tier MWLF #2 (36)	101243	West Burlington Township	Bradford
	057-058	Wayne Township MWLF (51)	100995	Wayne Township	Clinton
	059-060	White Pines MWLF (54)	301626	Pine Township	Columbia
Southwest Region	061-062	Arden Inc. MWLF (2)	100172	Washington	Washington
	063-064	Imperial MWLF (5)	100620	Imperial	Allegheny
	065-066	Brunner MWLF (6)	101439	Zelienople	Beaver
	067-068	Deep Valley C/DLF (12)	101176	North Fayette Township	Allegheny
	069-070	Evergreen MWLF (13)	100434	Coral	Indiana
	071-072	Greenridge Reclamation MWLF (16)	100281	Scottdale	Westmoreland
	073-074	J & J MWLF - CBF Inc.(Onyx Chestnut) (20)	100419	McClellandtown	Fayette
	075-076	Kelly Run Sanitation MWLF (21)	100663	Elizabeth	Allegheny
	077-078	Laurel Highland MWLF (25)	101534	Johnstown	Cambria
	079-080	MAX Environmental Tech (Noncaptive RW Disposal Impoundment) (28)	N/A	South Huntington	Westmoreland
	081-082	Monroeville (Chambers Development) MWLF (33)	100594	Monroeville	Allegheny
	083-084	Mostoller MWLF	101571	Somerset	Somerset
	085-086	Paris Flyash Noncaptive RWLF (38)	300936	Hanover Township	Beaver
	087-088	Westmoreland (Rostraver) MWLF (53)	100277	Belle Vernon	Westmoreland
	089-090	Shade MWLF (45)	101421	Caimbrook	Somerset
	091-092	South Hills MWLF (46)	100592	South Park / Library	Allegheny
093-094	Southern Alleghenies MWLF (47)	100081	Davidsville	Somerset	
095-096	Valley MWLF (50)	100280	Irwin	Westmoreland	
Northwest Region	097-098	Clarion County MWLF (8)	101187	Leeper	Clarion
	099-100	McKean Kness MWLF (29)	100361	Kane	McKean
	101-102	Lake View MWLF (23)	100329	Erie	Erie
	103-104	Northwest Sanitary MWLF (37)	100585	West Sunbury	Butler
	105-106	Seneca MWLF (44)	100403	Evans City / Mars	Butler
	107-108	Superior Greentree MWLF (48)	101397	Kersey	Elk

1.4 Project Organization and Responsibility

Specific individuals of the radiological SAP landfill leachate team were assigned the following project positions during performance of the monitoring activities:

- Project Oversight
 - EREF – Edward Repa/Bryan Staley
- SAP Operations and Data Management
 - Safety and Ecology Corporation – Andy Lombardo/Anita Mucha
- PADEP Contacts
 - PADEP BRP – David J. Allard/Jim Barnhart
 - PADEP Bureau of Waste Management - Steve Socash/Laura Henry
 - PADEP Bureau of Laboratories – Martina McGarvey
- Sampling Surveillance/Laboratory Shipments – PADEP Regional Offices
 - Region I (Southeast) – Kevin Bauer
 - Region II (Northeast) – William Tomayko
 - Region III (South Central) – Sam Sloan
 - Region IV (North Central) – Pat Brenan
 - Region V (Southwest) – Diane McDaniel
 - Region VI (Northwest) – Anita Stainbrook

2.0 FIELD SAMPLING PLAN AND LABORATORY ANALYSES

2.1 Sampling Locations, Frequency, and Media

Sampling and sample packaging for shipment were performed by authorized PADEP representatives. Representative samples of untreated leachate from each active landfill (Table 1-1) leachate management system were collected using sampling instructions developed by PADEP. The landfill facility and media to be sampled were determined by PADEP and specified on the DEP Sample Submission Sheet record (last page of Attachment A, PADEP Landfill Leachate Tritium Sampling Instructions) accompanying each sample. Additional details of each of these sampling methods are presented in the following subsections.

2.1.1 Sample Collection and Analysis

Samples of leachate were collected using up to two sample containers: one 500 ml amber glass bottle for the unfiltered sample and as necessary one quality control (QC) duplicate glass bottle. Duplicate sample bottles were labeled "FD". Each glass bottle was appropriately marked or labeled with the sample identification code and the analysis required. The sample containers did not contain a sample preservative (e.g., nitric acid) because ^3H adsorption onto container walls was deemed negligible and the 5-day holding time limit is therefore not applicable. Samples were not filtered because the laboratory analysis procedure utilizes evaporation during sample preparation.

Purging was performed to remove static leachate thereby allowing collection of a sample representative of leachate exiting the collection system. If the leachate collection tank was in active use (or its contents otherwise mixed), or the leachate was continuously exiting the collection system through a pipe, no purging was required. Otherwise, an appropriate volume was purged from the collection tank/pipe and, if indicated, purging continued until the clarity of the leachate was uniform.

Each sample collected was analyzed by PADEP's analytical laboratory for ^3H concentration using EPA Method 906.0 with a *Packard* TriCarb 2900TR liquid scintillation counter. The TriCarb counter is an ultra low background analyzer offering automatic window optimization to provide a high efficiency-to-background ratio. Internal quench correction is also provided to determine sample-specific detection efficiencies.

2.1.2 Sample Identification

The following information was recorded on the Sample Submission Sheet:

- Collector ID (i.e., "2899");
- Sequence Number, 3 digit number assigned from the SAP ID column of Table 1-1, the first number for the original sample and the second number for a duplicate if applicable;
- Date Collected, MM_DD_YY;
- Time Collected, xxxx;
- Cost Center, "197"; and
- Program, "0003".

The containers were marked with the date, time, Collector ID and Sequence Number recorded on the Sample Submission Sheet. The container was then affixed with a legal seal and the seal's unique ID was recorded on the Sample Submission Sheet.

The sampler name, telephone number and signature were also entered on the Sample Submission Sheet.

2.2 Quality Control

PADEP's analytical laboratory was chosen for this investigation because it has extensive experience analyzing ^3H and the sample matrices required by this investigation. Further, the laboratory maintains and implements an approved quality assurance program (QAP) to provide objective evidence that all measurements satisfy specific quality assurance objectives. Accordingly, performance evaluation samples (e.g., samples spiked with known concentrations of radionuclides in levels similar to those expected in the actual samples or blanks) were not prepared beyond those included in the laboratory's QAP to further document the accuracy and precision of their measurements process.

2.3 Sample Handling, Packaging, and Shipping

All personnel handling samples wore personal protective equipment commensurate with the level of hazard and facility procedures. The exterior of the filled sample container(s) was decontaminated as appropriate. Sample containers were properly secured pending shipment. The sample custodian/shipper was responsible for ensuring that bottle caps were checked for tightness. A tamper-evident seal was placed across bottle caps. Samples were properly packaged for custody transfer and shipment to the laboratory. Samples for radioactivity analysis did not require refrigeration.

2.4 Field Screening for Radioactivity

Screening filled sample containers for radioactivity was not performed prior to sample shipment.

2.5 Documentation

PADEP provided a copy of analytical results to host municipalities in accordance with the Municipal Waste Planning, Recycling, and Waste Reduction Act, 53 P.S. § 4000.1101(a)(3), which states that copies of all air and water quality monitoring data collected will be provided to the governing body of host municipalities for municipal waste landfills and resource recovery facilities within five working days after complete laboratory analysis of the data becomes available. PADEP also provided a copy of analytical results to the respective landfills in accordance with the Solid Waste Management Act, 35 P.S. §6018.608(3), which states that a copy of the results of analysis of any samples collected at any building, property, premises or place where solid waste is generated, stored, processed, treated, beneficially used or disposed will be furnished to the person having apparent authority over the building, property, premises or place within 5 business days.

3.0 ANALYTICAL LIMITATIONS AND REGULATORY BACKGROUND

3.1 Analytical Limitations

Any conclusions about the leachate results are subject to the following principal limitations:

- The EREF funded sampling campaign was performed as a quarterly composite grab sample of raw leachate collected from a leachate collection sump or manhole, or sampling port within the leachate collection system.
- Significant factors that are assumed to impact the ^3H leachate concentration include: the presence or absence of a disposal cell cap (percentage of the landfill that is active and uncovered); the introduction of new sources of ^3H disposed of in the landfill cell; the deterioration or breakage of tritium bearing refuse; the physical decay of ^3H ; and hydrogeological features such as the presence of debris that might conduct precipitation and leachate into the leachate collection system.

For samples obtained in 2004 and 2005, the minimum detectable concentrations (MDCs) for ^3H were 512 pCi/L and <275 pCi/L, respectively. These values are considered valid at the 95% confidence interval and can be differentiated from analytical noise. The MDC for all measurements in this study were 100 pCi/L.

Despite the fact that ^3H has a ubiquitous environmental presence⁵, leachate ^3H concentrations exceeding 200-300 pCi/L are greater than typical environmental concentrations found in Pennsylvania. For example, monthly ^3H concentrations in precipitation samples obtained in Harrisburg, Pennsylvania from January 1996 to March 2008 ranged from <160 to 166 pCi/L with the majority of results being below the MDC⁶.

The most likely source of leachate ^3H is NRC “generally licensed” GTLS devices that are unused and no longer needed or wanted (“disused sources”), and that are unknowingly disposed of as a solid waste. Most notable among these devices are GTLS emergency ‘EXIT’ signs that are used to satisfy the NFPA Life Safety Code 101 mandate for illuminated exit markers. Accidentally disposing of disused GTSLs in landfills is not an uncommon occurrence.⁷

Having recognized that the key to minimizing ^3H in landfill leachate is to prevent GTLS emergency ‘EXIT’ sign disposal in landfills, the PADEP has been performing outreach to the public, owners of GTLS emergency ‘EXIT’ signs, and landfill operators in an effort to educate

⁵ Tritium is produced naturally in the upper atmosphere by cosmic ray interaction with ^{14}N in air. Tritium is also produced artificially during nuclear weapons explosions, as a byproduct in nuclear power production, and in defense production reactors via neutron activation of ^6Li . In the atmosphere, tritium exists in low concentrations in three different chemical forms: hydrogen (HT), water vapor (HTO) and hydrocarbons (CH₃T). The steady-state global inventory is approximately 2.65 kilograms. By comparison, total U.S. tritium production since 1955 has been approximately 225 kilograms, an estimated 150 kilograms of which have decayed into helium-3, leaving an approximate inventory of 75 kilograms as of 1996.

⁶ http://oaspub.epa.gov/enviro/erams_query.simple_query (accessed March 30 2009).

⁷ December 2005 NRC Event Notification Report 42225 <http://www.nrc.gov/reading-rm/doc-collections/event-status/event/2005/20051229en.html>, (accessed June 27, 2009). A licensee removed 56 exit signs from a building prior to demolition and subsequently lost control of the signs. The licensee reported that “No paperwork was found for the disposal and it appears they were sent to a landfill with the general trash.” The total activity was estimated at 1,680 Ci.

and reduce the likelihood of these signs being disposed of in landfills. Additional information on ^3H and GTLS devices is available in PADEP (2005 and 2006a) and the PADEP internet site⁸.

3.2 Applicable or Relevant and Appropriate Requirement (ARAR) Standard of Consideration

The introduction of above-normal concentrations of ^3H to the environment from leachate effluent may have regulatory implications that are best understood in the context of ARAR standards for radioactive effluents. Both the NRC and the USEPA have promulgated ARARs for ^3H in liquid effluents. The Nuclear Regulatory Commission's annual average effluent concentration limit applies to licensed operations and is 1,000,000 pCi/L (10 CFR 20). The USEPA limits are based on the annual average concentration of ^3H in drinking water and are 20,000 pCi/L (40 CFR 141). Further detail on the regulatory background related to the NRC and USEPA limits can be found in Attachment B. PADEP Bureau of Radiation Protection (BRP) considers the more conservative 20,000 pCi/L standard as an ARAR for ^3H at any point of water intake to a drinking water supply.

⁸http://www.dep.state.pa.us/brp/Radiation_Control_Division/SolidWasteMonitoring/SolidWasteRadMonitoringFactSheets.htm (accessed June 27, 2009)

4.0 TRITIUM ANALYSIS RESULTS AND CONCLUSIONS

4.1 Summary of Results

Attachment C provides detailed ^3H concentration data by landfill facility and sampling quarter for each of the 54 active landfills in Pennsylvania during individual sampling events (8) from mid-2007 through the 1st quarter of 2009. Approximately 97% (416 out of 429) of ^3H measurements shown in Attachment C are above the MDC of 100 pCi/L and greater than typical ^3H concentrations in Pennsylvania precipitation. The leachate ^3H concentrations ranged from (-38)⁹ to 356,774 pCi/L, with a mean concentration of 38,091 pCi/L. Roughly 52% (216 out of 416) of the raw leachate samples had concentrations > 20,000 pCi/L. The action level at discharge column in Attachment C is defined as the leachate ^3H concentration that would result in a 2,000 pCi/L ^3H concentration (10% of the EPA 20,000 pCi/L MCL) at a downstream drinking water intake (Allard 2009, PADEP 2006b).

Figure 4-1 presents the leachate tritium sampling results from mid-2007 through the 1st quarter of 2009 at each of the 54 Pennsylvania landfills. The whisker plots show the maximum and minimum ^3H concentrations (end of whiskers) at each landfill, as well as the average (point) concentration for each landfill. The magnitude and range of the results suggest that gaseous tritium light source GTLS devices have been disposed of at many of the landfills in Pennsylvania.

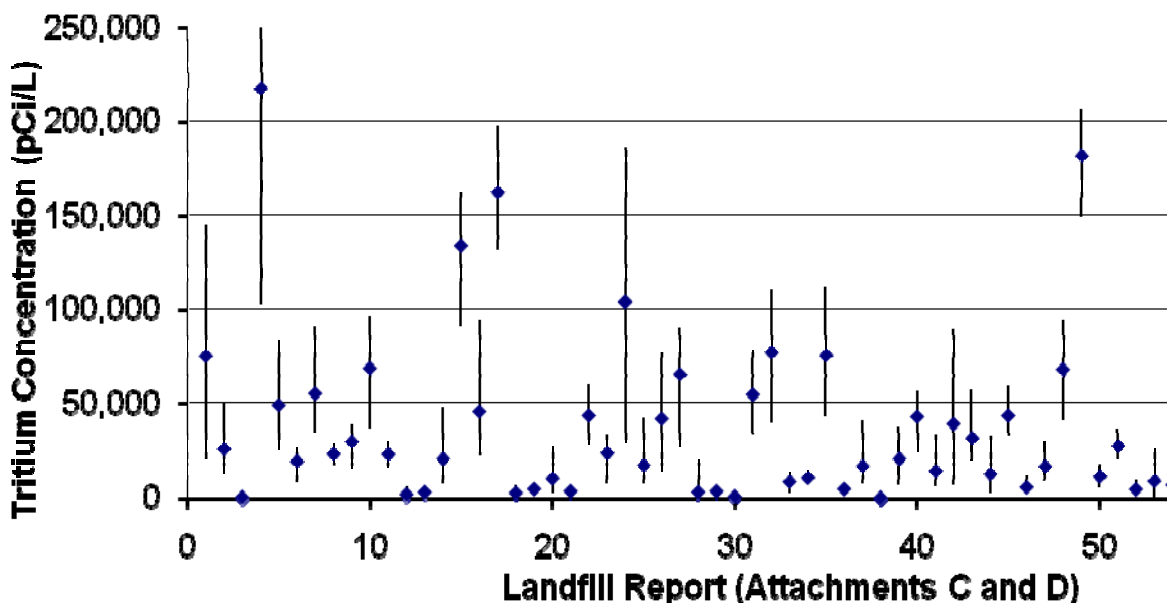


Figure 4-1. Tritium Results in Leachate from Pennsylvania Landfills.

⁹ The negative result (-62) observed in the 2005 data is not unexpected. Background radiation is a combination of the small amount of natural radioactivity in the environment and electronic noise contributing to laboratory instrument response. In addition, due to the randomness of radioactive sample emissions and the low concentration of tritium being measured, it is possible to obtain a background measurement that is larger than the actual sample measurement. When the larger background measurement is subtracted from the smaller sample result, a negative value is generated. The negative results are reported because they are essential when conducting statistical evaluations of data.

Figure 4-2 presents estimated diluted tritium concentrations for the same landfills at the nearest downstream drinking water intake based on dilution factors designated by the PADEP. These concentrations have been calculated by applying PADEP landfill-specific dilution factors available from the leachate discharge structure to the nearest downstream drinking water intake to each landfill. As shown in Figure 4-2, the ^3H activity concentrations at the nearest drinking water intake are 100 times less than the USEPA 20,000 pCi/L MCL.

NOTE: The landfills are presented in Figures 4-1 and 4-2 in alphabetical order consistent with the presentation of landfill data tables and individual landfill trend graphs in Attachments C, D, and E.

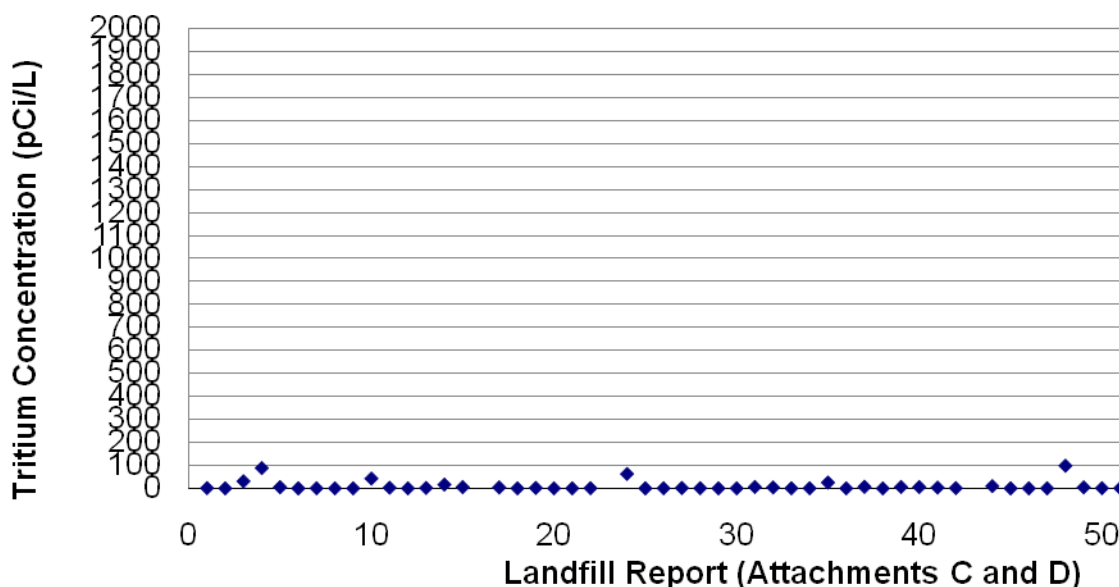


Figure 4-2. Diluted Tritium Results for Pennsylvania Landfills.
Assumes dilution is computed based on the distance from the landfill to the nearest downstream drinking water intake.

NOTE: 2,000 pCi/L is 10% of the EPA 20,000 pCi/L MCL at a downstream drinking water intake.

Attachment D presents the summary statistics (average or mean, standard deviation, minimum, maximum and median) for each of the 54 landfill leachate sample results from mid-2007 through the 1st quarter of 2009 (8 sampling events) as well as the average and maximum drinking water intake ^3H concentrations. Approximately 50% of the samples obtained from 2004 through the 1st quarter of 2009 (10 sampling events) had concentrations > 20,000 pCi/L. To evaluate the potential for a community water system (CWS)¹⁰ to be adversely affected if the CWS influent were located within these treated leachate discharge drainage areas, the average and maximum drinking water intake ^3H concentrations shown in Attachment D were calculated using the PADEP dilution factors, representing the dilution available from the leachate discharge structure

¹⁰ Community water systems are privately or publicly-owned and provide water for human consumption through pipes or other constructed conveyances to at least 15 service connections or serve an average of at least 25 people year-round.

to the downstream drinking water intake (PADEP 2006b). The average drinking water intake ^3H concentrations of this study were similar to those observed in 2004 and 2005, and were more than 200 times less than the EPA 20,000 pCi/L MCL, ranging from 0 to 99 pCi/L assuming leachate discharge to the lowest dilution river, creek or stream. Likewise the maximum drinking water intake ^3H concentrations were over 100 times less than the EPA 20,000 pCi/L MCL ranging from 0 to 146 pCi/L.

Attachment E presents a graph of the individual sample results from mid-2007 through the 1st quarter of 2009 for each of the 54 landfills. The sampling results and graphical data have generally been consistent with the results from the previous PADEP study and do not indicate any obvious increasing or decreasing trends in concentration. A review of the tabular data indicates the following:

- 20.4% of landfills (11 of 54) averaged <10,000 pCi/L through all 8 sample periods.
- 59.3% of landfills (32 of 54) averaged <50,000 pCi/L through all 8 sample periods.
- 85.2% of landfills (46 of 54) averaged <100,000 pCi/L through all 8 sample periods.
- 100% of landfills (54 of 54) measured < 1,000,000 pCi/L in all samples through all 8 sample periods¹¹.

4.2 Discussion

Spikes in the graphical data are assumed to reflect the rate of ^3H leachate flushing from a landfill by precipitation, which depends on several other factors such as: the presence or absence of a disposal cell cap (percentage of the landfill that is active and uncovered); the deterioration or breakage of tritium bearing refuse; and hydrogeological features such as the presence of debris that conduct precipitation and leachate into the leachate collection system.

Although the formation and migration of leachate is driven by precipitation, the entire state of Pennsylvania receives between 36 and 42 inches of precipitation annually, and as previously discussed, it contains relatively low-levels of ^3H ; consequently precipitation data was not included in the present study.

In 2006, PADEP compared leachate ^3H concentrations obtained from their 2004 and 2005 studies to the average amount of construction\demolition waste received annually at each landfill facility from 1992 through 2005. Analysis of the data showed that there is no clear association between leachate ^3H concentrations and the relative amounts of construction\demolition waste disposed at the facilities (PADEP 2006). The PADEP concluded that GTLS devices used as emergency 'EXIT' signs are entering landfills via other municipal or residual waste streams.

Recent studies of leachate ^3H concentrations from municipal solid waste and industrial waste landfills in New York, New Jersey, California, and the United Kingdom yielded results very similar to the present study (Robinson and Gronow 1996). Leachate sampling results from 6 active landfills in New York and New Jersey ranged from 1,254 to 191,835 pCi/L with a mean result of 49,900 pCi/L (Mutch, 2008.). According to Robinson and Gronow (1996) the results of a study of 10 landfills in California showed a mean leachate ^3H level of 99,000 pCi/L, and a peak

¹¹Although none of the landfills sampled are NRC-licensed facilities, all of the leachate ^3H concentrations measured from 2004 through 2009 are below the NRC effluent concentration limit discussed in Appendix B.

^3H concentration of 304,000 pCi/L. Likewise, a study of 30 active municipal solid waste landfills in the United Kingdom indicated a mean ^3H concentration of 24,900 pCi/L and a maximum level of 125,500 pCi/L.

The results of recent landfill leachate samples analyzed by the State of Tennessee showed no difference in the radioactivity levels between permitted landfills that accept very low level radioactive waste from nuclear facilities and those that do not¹². In response to public concerns raised over the Bulk Survey For Release (BSFR) program for disposal of very low level radioactive materials at some Tennessee Class I landfills, the Tennessee Division of Environmental Conservation (TDEC) sampled leachate from landfills around the state of Tennessee. The samples the state analyzed were taken at 5 landfills that accept BSFR material and also from 3 landfills where no BSFR material has ever been buried. Levels of ^3H in the 5 landfills that accept very low level radioactivity ranged from 224 to 34,000 pCi/L, similarly levels of ^3H in the 3 landfills that do not accept radioactivity ranged from 330 to 36,595 pCi/L.

4.3 Conclusions

Based on the results of the current study, the measurement of individual landfill ^3H leachate concentrations appears to be a suitable method to predict the impact on downstream drinking water supplies. Assuming that the current operational and disposal practices remain unchanged, it appears highly unlikely that downstream drinking water concentrations will exceed the USEPA MCL of 20,000 pCi/L for ^3H for drinking water.

Nevertheless, an unknown number of GTLS devices used as emergency 'EXIT' signs have not been properly disposed. Consequently, it appears prudent to conduct annual composite monitoring of ^3H in leachate to provide a mechanism to evaluate the success of the state and federal outreach program for proper management of disposed GTLS exit signs, and as ongoing assurances of no adverse impact from ^3H at the drinking water intakes.

¹² East TN Chapter of Health Physics Society <http://hpschapters.org/etchps/Leachate.pdf> (accessed July 3, 2009).

5.0 REFERENCES

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- PADEP (Pennsylvania Department of Environmental of Environmental Protection) 2005. *Radiological Investigation Results for Pennsylvania Landfill Leachate*, Pennsylvania Department of Environmental Protection, Bureau of Radiation Protection and Bureau of Waste Management, Harrisburg, Pennsylvania. October 3, 2005. This report is accessible via the world wide web at http://www.dep.state.pa.us/brp/Radiation_Control_Division/SolidWasteMonitoring/LF%20Leachate%20Final%2010_03_051_web.pdf or by request from BRP Radiation Control Division at 717-787-3720.
- PADEP (Pennsylvania Department of Environmental of Environmental Protection) 2006a. *Radiological Investigation Results for Pennsylvania Landfill Leachate Fall 2005 Tritium Update*, Pennsylvania Department of Environmental Protection, Bureau of Radiation Protection and Bureau of Waste Management, Harrisburg, Pennsylvania. April 7, 2006. This report is accessible via the world wide web at http://www.dep.state.pa.us/brp/Radiation_Control_Division/SolidWasteMonitoring/Fall%2005%20LF%20Leachate%20Tritium%20PRE%20FINAL_slw032906_8.pdf or by request from BRP Radiation Control Division at 717-787-3720.
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- Robinson, H.D., and J.R. Gronow 1996. "Tritium Levels in Leachates and Condensates from Domestic Waste in Landfill Sites," *Journal of the Chartered Institution of Water and Environmental Management*, volume 10, number 6, pp. 391-398.
- Semkow, T.M., R.S. Hafner, P.P Parekh, G.J. Wozniak, D.K. Haines, L. Husain, R.L. Rabun, and P.G. Williams 2002. *Study of Traces of Tritium at the World Trade Center*, UCRL-JC-150445, Lawrence Livermore National Laboratory, Livermore, CA. http://www.drjudywood.com/pdf/tritium_15002340.pdf (accessed May 26, 2009).

United States Nuclear Regulatory Commission News Release No. 09-011, NRC Requests Organizations to Report on Tritium Exit Signs in Their Possession, January 16, 2009.

10 CFR 20 *Appendix B. Annual Limits on Intake (ALIs) and Derived Air Concentrations (DACs) of Radionuclides for Occupational Exposure; Effluent Concentrations; Concentrations for Release to Sewerage*. Code of Federal Regulations (CFR) Title 10, Energy, Part 20. <http://www.nrc.gov/reading-rm/doc-collections/cfr/part020/appb/hydrogen-3.html> (accessed May 25, 2009).

40 CFR 141.16 *Maximum contaminant levels for beta particle and photon radioactivity from man-made radionuclides in community water systems*. Code of Federal Regulations (CFR) Title 40, Protection of the Environment, Part 141. http://edocket.access.gpo.gov/cfr_2002/julqtr/pdf/40cfr141.16.pdf (accessed May 25, 2009).

ATTACHMENT A
SAMPLE PLAN

PADEP Landfill Leachate Tritium Sampling Instructions
Environmental Research and Education Foundation Project

September 2, 2008

I. SCOPE AND APPLICABILITY

These instructions are for sampling landfill (LF) untreated leachate effluent for the radionuclide Tritium. Sampling will be performed at the permitted LF's listed in the chart below.

II. SAMPLING AND ANALYSIS PLAN (SAP) REQUIREMENTS

A. Sample Location: Effluent from LF leachate collection system upstream of any leachate treatment.

B. Sample Frequency: Single continuous grab composite.

C. Analytical Parameters: Tritium by liquid scintillation counting (EPA Method 906.0).

D. Quality Control Samples: 10% of the total sample collections by Region as field duplicates (i.e., For every 10 samples collected per Region, one field duplicate should also be collected).

E. Contact Information:

- PADEP Waste Management – Laura Henry (717) 787-7381
- PADEP Radiation Protection – Jim Barnhart (717) 772-0178
- PADEP Bureau of Laboratories – Martina McGarvey (717) 346-8618
<http://intradep/bol/bol.htm>
- Environmental Research and Education Foundation (EREF) – Ed Repa (703) 299-5139
- Safety and Ecology Corporation (SEC) – Anita Mucha (724) 554-0037
- Regional DEP Contacts and Sample Support:

Region	Name	Phone	Email	Address
NERO	Bill Tomayko Program Manager	(570) 826-2201	wtomayko@state.pa.us	2 Public Square Wilkes-Barre, PA 18711-0790
SERO	Kevin Bauer Solid Waste Supervisor	(484) 250-5745	kbauer@state.pa.us	2 East Main Street Norristown, PA 19401
NCRO	Pat Brennan Operations Manager	(570) 327-3650	pbrennan@state.pa.us	208 West Third Street Suite 101 Williamsport, PA 17701
SCRO	Sam Sloan Operations Manager	(717) 705-6638	ssloan@state.pa.us	909 Elmerton Avenue Harrisburg, PA 17110-8200
NWRO	Anita Stainbrook Operations Manager	(814) 332-6827	astainbroo@state.pa.us	230 Chestnut Street Meadville, PA 16335-3481
SWRO	Diane McDaniel Facilities Manager	(412) 442-5244	dimcdaniel@state.pa.us	400 Waterfront Drive Pittsburgh, PA 15222-4745

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III. PRECAUTIONS AND LIMITATIONS

- A. Samples shall be representative of leachate exiting the leachate collection system prior to treatment.
- B. Samples shall be collected by personnel qualified per the LF operator's health and safety plan/program (HASP). Qualified personnel shall observe all required and prudent measures to protect themselves including the use of appropriate personnel protective equipment (PPE).
- C. Samples should not be filtered.
- D. Purged leachate and other waste material produced during sampling shall be dispositioned in accordance with the LF permit and HASP.
- E. One 500 mL wide mouth amber glass container shall be used for sample collection.
- F. Deviations from Section IV of these instructions are permitted only at the direction of the designated PADEP Waste Management representative. Such deviations shall be documented in the "Additional Information" section of the PADEP Sample Submission Sheet (see attached sample).

IV. METHODOLOGY

A. Preliminary Activities

1. Create sampling kits containing the following items:

- 1 – 500 mL wide mouth amber glass bottle*
- 1 – DEP Sample Submission Sheet*
- 1 – DEP Legal Seal*
- 1 – Ziploc bag
- Absorbent wipes

*Note: If a field duplicate sample is to be taken, a second bottle, Sample Submission Sheet and DEP Legal Seal should be included in the kit.

2. Verify that the sample identification codes marked on the bottles match those entered on the DEP Sample Submission Sheet. Bottles containing duplicate samples should be labeled "FD" and noted as such on their corresponding Sample Submission Sheets.

B. Leachate Purging

Purging is performed to remove static leachate thereby allowing collection of a sample representative of leachate exiting the collection system. If the leachate collection tank is in active use (or its contents otherwise mixed), or the leachate is continuously exiting the collection system through a pipe, no purging is required. Otherwise, purge an appropriate volume from the collection tank/pipe and, if indicated, continue purging until the clarity of the leachate is uniform.

C. Sample Collection

1. Immediately after purging, collect leachate directly and continuously into the glass sample container(s). Replace the caps on the container. No sample chemical preservation is necessary.

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2. Enter the Collector ID (2899), unique Sequence Number (3 digits, assigned in the chart below), Date Collected (mm/dd/yy), Time Collected (xxxx), Cost Center (197), and Program (0003) in the appropriate blocks on the DEP Sample Submission Sheet.
3. If leachate wetted the outside of any container, clean it with an absorbent wipe.
4. Mark the containers with the date, time, Collector ID and Sequence Number recorded on the DEP Sample Submission Sheet. If the container holds a duplicate sample, also mark it with "FD".
5. Affix a Legal Seal across the cap of each sample container. Record the Legal Seal's unique ID in the appropriate block on the DEP Sample Submission Sheet. Place the sample in the Ziploc bag and seal.
6. Complete the "Sampler Name, Telephone number, and Signature" fields at the bottom of the DEP Sample Submission Sheet.
7. Package the sample containers for shipment per Section IV-D.

D. Sample Packaging and Shipment

1. Place the glass bottle(s) upright in a DEP sample cooler, ensuring they are cushioned by packing material and add enough ice to ensure their arrival at the lab in a cool condition. This will reduce the possibility of pressure buildup, resulting in sample container breakage, due to microbial action.
2. Put the DEP Sample Submission Sheet in a Ziploc bag and tape the Ziploc bag to the lid of the cooler. Place the cooler in the locked sample pickup location for pickup by the DEP bonded courier, U.S. Cargo, for delivery to the DEP Bureau of Laboratories.

V. DOCUMENTATION

1. Completed DEP Sample Submission Sheet (original retained by analytical laboratory).
2. Analytical results will be e-mailed to:
 - PADEP Waste Management – Laura Henry: lahenry@state.pa.us
 - Safety and Ecology Corporation (SEC) – Anita Mucha: amucha@sec-tn.com
 - Environmental Research and Education Foundation (EREF) – Ed Repa: erepa@erefdn.org
3. PADEP will provide a copy of analytical results to host municipalities in accordance with the Municipal Waste Planning, Recycling, and Waste Reduction Act, 53 P.S. § 4000.1101(a)(3), which states that copies of all air and water quality monitoring data collected will be provided to the governing body of host municipalities for municipal waste landfills and resource recovery facilities within five working days after complete laboratory analysis of the data becomes available.
4. PADEP will also provide a copy of analytical results to the respective landfills in accordance with the Solid Waste Management Act, 35 P.S. §6018.608(3), which states that a copy of the results of analysis of any samples collected at any building, property, premises or place where solid waste is generated, stored, processed, treated, beneficially used or disposed will be furnished to the person having apparent authority over the building, property, premises or place within five business days.

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VI. SAMPLE LOCATIONS and ID NUMBERS

Leachate Sample Collections at Active Pennsylvania Solid Waste Landfills				
	Sequence No.	Facility Name	City	County
Southeast Region	001-002	Bethlehem Steel Corp RWLF	Coatesville	Chester
	003-004	GROWS MWLF	Morrisville	Bucks
	005-006	Pottstown MWLF	Pottstown	Montgomery
	007-008	SECCRA MWLF	West Grove Kennett Sq.	Chester
	009-010	Tullytown Resource Recovery MWLF	Tullytown	Bucks
Northeast Region	011-012	Alliance Sanitary MWLF	Taylor	Lackawanna
	013-014	Chrin Brothers, Inc. MWLF	Easton	Northampton
	015-016	Commonwealth Environmental Systems MWLF	Foster Township Hegers	Schuylkill
	017-018	Grand Central Sanitary MWLF	Pen Argyl	Northampton
	019-020	IESI Bethlehem MWLF	Bethlehem	Northampton
	021-022	Keystone Sanitary MWLF	Dunmore	Lackawanna
	023-024	Pine Grove MWLF	Pine Grove	Schuylkill
Southcentral Region	025-026	Cumberland County MWLF	Shippensburg / Newburg	Cumberland
	027-028	Conestoga MWLF	Morgantown	Berks
	029-030	Greater Lebanon Refuse Authority MWLF	Lebanon	Lebanon
	031-032	IESI Blue Ridge MWLF	Scotland	Franklin
	033-034	Lancaster County SWA (Frey Farm) Resource Recovery LF/Transfer Station	Bainbridge / Conestoga	Lancaster
	035-036	Lanchester MWLF	Narvon	Lancaster
	037-038	Mifflin County SWA MWLF	Lewistown	Mifflin
	039-040	Milton Grove C/DLF	Mt. Joy Township	Lancaster
	041-042	Modern MWLF	York	York
	043-044	Mountain View MWLF	Greencastle	Franklin
	045-046	Pioneer Crossing MWLF	Birdsboro / Harleysville	Berks
	047-048	Delaware County SWA (Rolling Hills) MWLF	Boyertown	Berks
	049-050	Sandy Run MWLF	Hopewell	Bedford
051-052	Western Berks Community MWLF	Birdsboro	Berks	

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Northcentral Region	053-054	Lycoming County MWLF	Brady Township	Lycoming
	055-056	Northern Tier MWLF #2	West Burlington Twp.	Bradford
	057-058	Wayne Township MWLF	Wayne Township	Clinton
	059-060	White Pines RWLF	Pine Township	Columbia
Southwest Region	061-062	Arden Inc. MWLF	Washington	Washington
	063-064	BFI Imperial MWLF	Imperial	Allegheny
	065-066	Brunner MWLF	Zelienople	Beaver
	067-068	Deep Valley C/DLF	North Fayette Township	Allegheny
	069-070	Evergreen MWLF	Coral	Indiana
	071-072	Greenridge Reclamation MWLF	Scottdale	Westmoreland
	073-074	J&J MWLF – CBF, Inc. (Onyx Chestnut)	McClellandtown	Fayette
	075-076	Kelly Run Sanitation MWLF	Elizabeth	Allegheny
	077-078	Laurel Highland MWLF	Johnstown	Cambria
	079-080	MAX Environmental Tech (Noncaptive RW Disposal Impoundment)	South Huntington	Westmoreland
	081-082	Monroeville (Chambers Development) MWLF	Monroeville	Allegheny
	083-084	Mostoller MWLF	Somerset	Somerset
	085-086	Paris Flyash Noncaptive RWLF	Hanover Township	Beaver
	087-088	Westmoreland (Rostraver) MWLF	Belle Vernon	Westmoreland
	089-090	Shade MWLF	Caimbrook	Somerset
	Northwest Region	091-092	South Hills MWLF	South Park / Library
093-094		Southern Alleghenies MWLF	Davidsville	Somerset
095-096		Valley MWLF	Irwin	Westmoreland
097-098		Clarion County MWLF	Leeper	Clarion
099-100		McKean Kness MWLF	Kane	McKean
101-102		Lake View MWLF	Erie	Erie
103-104		Northwest Sanitary MWLF	West Sunbury	Butler
105-106		Seneca MWLF	Evans City / Mars	Butler
107-108	Superior Greentree MWLF	Kersey	Elk	

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Fixed: <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>	DEP Laboratory Sample Submission Sheet	LAB USE ONLY Lab Number: _____ Date Received: _____
Collector ID: <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> Seq. No.: <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> Date Collected: (MM-DD-YY) <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> Time Collected: <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>		SAC or Suite Code: <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> Legal Seal Number _____ _____ _____
Reason: <input type="text"/> <input type="text"/> Cost Center: <input type="text"/> <input type="text"/> <input type="text"/> Program: <input type="text"/> <input type="text"/> <input type="text"/> SPN: <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> Matrix Code: <input type="text"/> <input type="text"/> <input type="text"/> Residual Chlorine: YES <input type="checkbox"/> NO <input type="checkbox"/> pH less than 2.0? YES <input type="checkbox"/> NO <input type="checkbox"/>		Check If Broken: <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
LAB USE ONLY		
Custody Log Date: _____ Additional Information: _____ How Shipped: _____ Received by: _____		

Addressee : _____
 Address 1 : _____
 Address 2 : _____
 City : _____ State: _____ Zip: _____

Sampling Location: _____

Collector Name (Please PRINT) : _____
 Signature: _____ Date: _____ Phone: _____

= Required Information

ATTACHMENT B
NRC AND EPA REGULATORY CONSIDERATIONS

NRC Limitations

In Subpart K of 10 CFR 20, the NRC authorizes licensees to dispose of licensed material in effluents [§20.2001(a)(3)] and sanitary sewers [(§20.2001(a)(4)] within nuclide-specific effluent concentration limitations. The effluent concentration limits were established to ensure that the total effective dose equivalent (TEDE) to individual members of the public from all licensed operational radiation sources does not exceed 100 mrem (1 mSv) in a year [§20.1301(a)(1)]. To accomplish this objective, the NRC derived annual average liquid effluent concentration limits (e.g., 1×10^6 pCi/L as ^3H) corresponding to a 'Reference Man' TEDE of 50 mrem/year. In contrast, the monthly average concentration sanitary sewer limits (e.g., 1×10^7 pCi/L as ^3H) were derived to correspond to a 'Reference Man' committed effective dose equivalent (CEDE) of 500 mrem. Section 20.1301(a)(1) specifically excludes dose contributions attributed to radionuclides in sanitary sewer discharges from licensee compliance demonstrations with the 100 mrem/year public TEDE limit. The practice of radionuclide disposal by release into sanitary sewerage is limited by several §20.2003 conditions, most importantly that the:

- Released materials are readily soluble (or dispersible biological material);
- Quantity of material released in month, divided by the average monthly volume of water released into the sewer by the licensee, does not exceed the Appendix B, Table 3 monthly average sewer concentration limits (e.g., 1×10^7 pCi/L as ^3H); and
- Total annual quantity of radioactive material released into sanitary sewerage does not exceed 5 Ci of ^3H , 1 Ci of ^{14}C , and 1 Ci of all other radioactive material combined.

USEPA Limitations

In a final rulemaking for Subpart G of the NPDWR (40 CFR 141) in 2000, the EPA established MCL for radionuclides (§141.66) in drinking water furnished by any CWS¹³ including a MCL for 'beta particle and photon radioactivity' (§141.66(d)). This CWS MCL indirectly limits the beta particle and photon radioactivity in drinking water to annual average concentration not to exceed an annual dose equivalent to the total body or any internal organ of 4 mrem/year. For all radionuclides except ^3H and ^{90}Sr , conversion of activity concentration to dose equivalent must be performed assuming a drinking water ingestion rate of 2 L/day and the National Bureau of Standards (NBS) Handbook 69 (published 1959 and amended 1963; also referred to as NCRP Report 22) compilation of maximum permissible concentrations (MPCs) in water.

In Table A of §141.66, the USEPA directly established 20,000 pCi/L as the annual average concentration of tritium in drinking water that was assumed to produce a total body or organ dose of 4 mrem/year, the MCL. The concentrations for these contaminants were derived from a historical dosimetry model (ICRP Publication 2) used at the time the Subpart G rule was promulgated in 1976. When these risks were calculated in accordance with the latest dosimetry models described in Federal Guidance Report 13 (FGR 13)¹⁴ the risks associated with these concentrations, while varying considerably, generally fall within the USEPA's current risk target range for drinking water contaminants of 10^{-4} to 10^{-6} . Accordingly, USEPA did not change the MCL for beta particle and photon radioactivity during its final rulemaking in 2000. Using

¹³ Community water systems are privately or publicly-owned and provide water for human consumption through pipes or other constructed conveyances to at least 15 service connections or serve an average of at least 25 people year-round.

¹⁴ <http://www.epa.gov/radiation/docs/federal/402-r-99-001.pdf> accessed March 28, 2006.

contemporary ICRP Publication 30 dosimetry, the concentration of ^3H [as HTO] needed to deliver the MCL 4 mrem in one year is approximately 86,000 pCi/L, over four times the concentration in the current NPDWS. Thus, the current EPA 20,000 pCi/L MCL appears to be conservative by over a factor of four.

ATTACHMENT C

**DETAILED TRITIUM CONCENTRATION DATA
BY FACILITY AND SAMPLING QUARTER**

Attachment C
Detailed Tritium Concentration Data By Facility and Sampling Quarter

Pennsylvania Landfill Leachate Tritium Study Sample Results (all results in units of pCi/liter)											
General Facility Information			2007			2008				2009	Action Level at Discharge ^a
Facility Name	County	Municipality	2 nd Q	3 rd Q	4 th Q	1 st Q	2 nd Q	3 rd Q	4 th Q	1 st Q	
Alliance Sanitary MWLF	Lackawanna	Ransom & Taylor Boros	19,876	42,400	36,935	25,618	101,399	120,722	144,749	108,187	127,176,686
Arden, Inc MWLF	Washington	Chartiers Twp	19,309	16,491	26,440	21,925	38,237	50,777	11,801	20,289	1,809,424,400
Bethlehem Steel Corp RWLF	Chester	E. Fallowfield Twp	378	421	44	171	215	297	226	368	17,123
BFI Conestoga MWLF	Berks	New Morgan Boro	356,774	325,484	192,387	171,237	102,306	264,081	143,097	184,699	4,894,795
BRI Imperial MWLF	Allegheny	Findley Twp	24,611	39,511	57,199	29,476	35,830	54,809	83,796	65,406	18,998,956
Brunner MWLF	Beaver	New Sewickley Twp	25,449	24,211	18,298	10,066	16,280	26,053	26,286	7,545	121,489,924
Chrin Brothers, Inc MWLF	Northampton	Williams Twp	33,788	51,112	52,370	40,618	38,366	69,898	89,868	62,943	155,868,988
Clarion County MWLF	Clarion	Farmington Twp	17,095	18,851	27,310	28,163	28,664	23,055	23,173	18,087	214,645,036
Commonwealth Env Sys MWLF	Schuylkill	Foster Twp	15,232	38,134	38,610	20,383	31,068	36,477	23,613	33,429	555,320,965
Cumberland County MWLF	Cumberland	Hopewell Twp	60,363	76,609	70,620	43,045	36,516	79,716	96,000	85,786	3,205,266
DCSWA Rolling Hills MWLF	Berks	Exeter Twp	27,479	30,190	23,729	16,615	25,200	15,583	26,199	18,315	16,317,131
Deep Valley C&D LF	Allegheny	North Fayette Twp	5,524	987	1,204	592	977	367	2,260	1,909	50,935,539
Evergreen MWLF	Indiana	Brush Valley Twp	1,553	1,528	4,338	2,357	2,787	4,296	3,170	3,153	2,979,088
GLRA MWLF	Lebanon	North Lebanon Twp	20,155	47,402	13,702	8,027	11,043	17,552	7,447	38,690	2,487,959
Grand Central Sanitary MWLF	Northampton	Plainfield Twp	90,162	158,650	161,555	127,520	124,674	128,255	144,353	135,306	**

Pennsylvania Landfill Leachate Tritium Study Sample Results (all results in units of pCi/liter)											
General Facility Information			2007			2008				2009	Action Level at Discharge ^a
Facility Name	County	Municipality	2 nd Q	3 rd Q	4 th Q	1 st Q	2 nd Q	3 rd Q	4 th Q	1 st Q	
Greenridge Reclamation MWLF	Westmoreland	East Huntingdon Twp	51,054	93,517	68,027	34,972	41,691	25,137	21,968	27,073	*
GROWS MWLF	Bucks	Falls Twp	137,015	197,212	168,574	164,433	131,242	171,742	168,273	158,834	79,743,918
IESI Bethlehem MWLF	Northampton	Lower Saucon Twp	1,283	2,894	6,311	1,388	3,946	1,851	1,176	861	173,187,764
IESI Blue Ridge MWLF	Franklin	Greene Twp	6,313	6,969	6,623	2,422	1,820	3,497	3,154	5,192	4,932,836
J&J (Onyx Chestnut) MWLF	Fayette	German Twp	27,031	7,256	5,891	9,005	2,914	13,700	2,407	12,146	73,927,911
Kelly Run Sanitation MWLF	Allegheny	Forward Twp	2,628	6,532	4,945	2,461	2,288	3,103	2,081	2,854	66,819,458
Keystone Sanitary MWLF	Lackawanna	Dunmore Boro	56,455	55,879	38,958	35,174	27,479	28,248	44,597	59,547	90,840,490
Lake View MWLF	Erie	Summit Twp	29,831	30,282	33,478	13,327	32,503	27,999	13,853	6,900	*
Lanchester MWLF	Lancaster	Caernarvon Twp	137,694	185,766	68,266	28,130	86,321	161,194	127,736	33,877	***
Laurel Highland MWLF	Cambria	Jackson Twp	23,086	10,784	41,683	11,293	13,033	10,683	7,451	19,020	165,433,088
LCSWMA Frey Farm MWLF	Lancaster	Manor Twp	34,497	58,284	13,870	32,928	33,984	52,243	29,388	76,941	220,171,977
Lycoming Co (Allenwood) MWLF	Lycoming	Brady Twp	68,845	77,997	89,411	26,058	43,046	60,686	79,819	76,941	82,931,952
MAX Env Tech RW impoundment	Westmoreland	South Huntingdon Twp	N/D	37	19,936 ¹	198	42	67	123	30	7,872,171
McKean Kness MWLF	McKean	Sergeant Twp	3,540	3,566	2,838	3,081	2,613	3,071	4,314	3,816	23,996,414
Mifflin County SWA MWLF	Mifflin	Derry Twp	637	585	620	373	557	613	710	563	59,300,464
Milton Grove C&D LF	Lancaster	Mount Joy Twp	67,478	78,330	39,524	37,645	57,758	72,508	33,536	47,750	****

Pennsylvania Landfill Leachate Tritium Study Sample Results (all results in units of pCi/liter)											
General Facility Information			2007			2008				2009	Action Level at Discharge ^a
Facility Name	County	Municipality	2 nd Q	3 rd Q	4 th Q	1 st Q	2 nd Q	3 rd Q	4 th Q	1 st Q	
Modern MWLF	York	Lower Windsor Twp	57,662	78,351	77,043	74,092	#	38,839	110,188	102,921	37,429,236
Monroeville (Chambers) MWLF	Allegheny	Monroeville Boro	10,598	10,024	8,766	2,538	2,900	9,319	9,082	13,703	37,997,912
Mostoller MWLF	Somerset	Somerset Twp	9,436	7,095	6,968	9,486	9,496	13,954	14,611	12,270	*****
Mountain View MWLF	Franklin	Antrim Twp	62,124	76,288	48,359	42,946	48,035	103,380	110,362	111,793	5,919,403
Northern Tier #2 MWLF	Bradford	West Burlington Twp	6,118	4,308	5,531	3,407	3,663	4,874	3,353	4,890	397,427,145
Northwest Sanitary MWLF	Butler	Clay Twp	16,671	15,504	10,185	7,361	15,876	17,858	40,299	10,143	4,858,351
Paris Flyash Noncaptive RWLF	Beaver	Hanover Twp	N/D	30	-38	68	13	42	67	45	542,827,320
Pine Grove MWLF	Schuylkill	Pine Grove Twp	20,169	30,347	36,765	6,601	11,090	27,958	21,526	9,990	6,720,719
Pioneer Crossing MWLF	Berks	Exeter Twp	56,017	55,054	44,255	23,804	28,653	39,860	39,858	53,917	14,504,116
Pottstown MWLF	Montgomery	West Pottsgrove Twp	7,121	33,708	10,440	27,693	6,910	13,975	5,421	6,561	8,702,470
Sandy Run MWLF	Bedford	Broad Twp	6,710	26,845	15,604	19,257	67,740	88,826	14,636	71,063	60,529,554
SECCRA MWLF	Chester	London Grove Twp	19,731	53,432	56,787	18,999	19,038	36,724	26,689	21,137	*
Seneca MWLF	Butler	Jackson Twp	20,155	3,827	5,357	2,347	2,869	18,504	32,569	14,051	2,536,801
Shade MWLF	Somerset	Shade Twp	32,506	34,738	41,266	47,337	34,688	58,875	54,006	42,346	397,039,411
South Hills MWLF	Allegheny	Union Twp	3,393	11,286	3,569	3,328	4,796	5,043	7,301	4,773	89,092,611
Southern Alleghenies MWLF	Somerset	Conemaugh Twp	9,355	8,453	22,401	9,079	15,303	19,931	30,090	18,146	132,346,470

Pennsylvania Landfill Leachate Tritium Study Sample Results (all results in units of pCi/liter)													
General Facility Information			2007			2008				2009	Action Level at Discharge ^a		
Facility Name	County	Municipality	2 nd Q	3 rd Q	4 th Q	1 st Q	2 nd Q	3 rd Q	4 th Q	1 st Q			
Superior Greentree MWLF	Elk	Fox Twp	46,041	71,741	88,651	40,280	93,717	64,665	68,031	70,340	1,375,163		
Tullytown RR MWLF	Bucks	Falls Twp	148,794	206,052	177,637	188,192	178,899	176,520	192,531	185,320	79,743,918		
Valley MWLF	Westmoreland	Penn Twp	6,741	13,726	18,076	5,573	5,060	15,039	17,160	7,492	26,727,783		
Wayne Township MWLF	Clinton	Wayne Twp	20,092	36,136	32,580	26,053	28,359	24,850	25,263	24,654	69,545,904		
Western Berks Comm MWLF	Berks	Cumru Twp	3,646	9,159	2,889	2,100	3,650	3,908	3,684	5,638	37,296,299		
Westmoreland (Rostraver) MWLF	Westmoreland	Rostraver Twp	1,967	2,465	-31	8,323	8,001	25,828	7,727	15,563	73,927,911		
White Pines RWLF	Columbia	Pine Twp	18,301	12,149	4,401	2,482	3,687	1,693	2,221	8,246	6,074,496		
Sample Event Summary Statistics			Average:	37,471	46,085	37,984	28,149	31,457	43,310	40,802	39,472		
			Median:	20,124	28,518	23,065	14,971	16,280	24,994	22,571	18,230		
			Stdev:	56,967	62,641	46,069	42,027	38,924	54,049	49,909	47,479		
			Min:	378	30	-38	68	13	42	67	30		
			Max:	356,774	325,484	192,387	188,192	178,899	264,081	192,531	185,320		

a. (PADEP 2006b)

*No discharge at present time

**Unnamed tributary of Waltz Creek: 49,500,682

Unnamed tributary of Little Bushkill: 77,934,494

***Conestoga River: 3,286,506

Schuylkill River: 18,648,149

Chickies Creek: 220,171,977

No Sample

****Little Chiques Creek: 839,220,542

Swatara Creek: 17,850,824

*****Conemaugh River: 248,149,632

Kimerbly Run: 35,219,154

¹Analytical result is an outlier.

N/D Non-Detect

ATTACHMENT D
ANALYTICAL DATA SUMMARY

Attachment D

**Analytical Data Summary of 2007, 2008 and 2009 Samples (8 total) By Landfill
 (all concentrations in units of pCi/liter)**

Facility Name	Leachate Average	Leachate STDEV	Leachate MIN	Leachate MAX	Leachate Median	Average Drinking Water Intake ^a	Maximum Drinking Water Intake ^a
Alliance Sanitary MWLF	74,986	48,906	19,876	144,749	71,900	1.18	2.28
Arden, Inc MWLF	25,659	12,811	11,801	50,777	21,107	0.03	0.06
Bethlehem Steel Corp RWLF	265	126	44	421	262	30.95	49.17
BFI Conestoga MWLF	217,508	89,347	102,306	356,774	188,543	88.87	145.78
BFI Imperial MWLF	48,830	20,072	24,611	83,796	47,160	5.14	8.82
Brunner MWLF	19,274	7,463	7,545	26,286	21,255	0.32	0.43
Chrin Brothers, Inc MWLF	54,870	18,732	33,788	89,868	51,741	0.70	1.15
Clarion County MWLF	23,050	4,684	17,095	28,664	23,114	0.21	0.27
Commonwealth Env Sys MWLF	29,618	8,827	15,232	38,610	32,249	0.11	0.14
Cumberland County MWLF	68,582	20,661	36,516	96,000	73,615	42.79	59.90
DCSWA Rolling Hills MWLF	22,914	5,412	15,583	30,190	24,465	2.81	3.70
Deep Valley C&D LF	1,728	1,659	367	5,524	1,096	0.07	0.22
Evergreen MWLF	2,898	1,080	1,528	4,338	2,970	1.95	2.91
GLRA MWLF	20,502	14,760	7,447	47,402	15,627	16.48	38.11
Grand Central Sanitary MWLF	133,809	22,549	90,162	161,555	131,780	5.41	6.53
Greenridge Reclamation MWLF	45,430	24,719	21,968	93,517	38,332	ND	ND
GROWS MWLF	162,166	20,714	131,242	197,212	166,353	4.07	4.95
IESI Bethlehem MWLF	2,464	1,865	861	6,311	1,620	0.03	0.07
IESI Blue Ridge MWLF	4,499	2,024	1,820	6,969	4,344	1.82	2.83
J&J (Onyx Chestnut) MWLF	10,044	7,943	2,407	27,031	8,131	0.27	0.73
Kelly Run Sanitation MWLF	3,362	1,560	2,081	6,532	2,741	0.10	0.20
Lake View MWLF	23,522	10,413	6,900	33,478	28,915	ND	ND
Lanchester MWLF	103,623	58,453	28,130	185,766	107,029	63.06	113.05
Laurel Highland MWLF	17,129	11,137	7,451	41,683	12,163	0.21	0.50
LCSWMA Frey Farm MWLF	41,517	19,793	13,870	76,941	34,241	0.38	0.70
Lycoming Co (Allenwood) MWLF	65,350	21,240	26,058	89,411	72,893	1.58	2.16

Analytical Data Summary of 2007, 2008 and 2009 Samples (8 total) By Landfill
(all concentrations in units of pCi/liter)

Facility Name	Leachate Average	Leachate STDEV	Leachate MIN	Leachate MAX	Leachate Median	Average Drinking Water Intake ^a	Maximum Drinking Water Intake ^a
MAX Env Tech RW impoundment	2,919	7,504	30	¹	67	0.74	5.06
McKean Kness MWLF	3,355	559	2,613	4,314	3,311	0.28	0.36
Mifflin County SWA MWLF	582	97	373	710	599	0.02	0.02
Milton Grove C&D LF	54,316	17,173	33,536	78,330	52,754	6.09	8.78
Modern MWLF	77,014	24,542	38,839	110,188	77,043	4.12	5.89
Monroeville (Chambers) MWLF	8,366	3,811	2,538	13,703	9,201	0.44	0.72
Mostoller MWLF	10,415	2,907	6,968	14,611	9,491	0.59	0.83
Mountain View MWLF	75,411	29,374	42,946	111,793	69,206	25.48	37.77
Northern Tier #2 MWLF	4,518	1,015	3,353	6,118	4,591	0.02	0.03
Northwest Sanitary MWLF	16,737	10,233	7,361	40,299	15,690	6.89	16.59
Paris Flyash Noncaptive RWLF	32	37	-38	68	42	0.00	0.00
Pine Grove MWLF	20,556	10,760	6,601	36,765	20,848	6.12	10.94
Pioneer Crossing MWLF	42,677	12,123	23,804	56,017	42,058	5.88	7.72
Pottstown MWLF	13,979	10,791	5,421	33,708	8,781	3.21	7.75
Sandy Run MWLF	38,835	31,753	6,710	88,826	23,051	1.28	2.93
SECCRA MWLF	31,567	15,713	18,999	56,787	23,913	ND	
Seneca MWLF	12,460	10,836	2,347	32,569	9,704	9.82	25.68
Shade MWLF	43,220	9,580	32,506	58,875	41,806	0.22	0.30
South Hills MWLF	5,436	2,694	3,328	11,286	4,785	0.12	0.25
Southern Alleghenies MWLF	16,595	7,618	8,453	30,090	16,724	0.25	0.45
Superior Greentree MWLF	67,933	18,396	40,280	93,717	69,186	98.80	136.30
Tullytown RR MWLF	181,743	16,473	148,794	206,052	182,110	4.56	5.17
Wayne Township MWLF	27,248	5,039	20,092	36,136	25,658	0.78	1.04
Western Berks Comm MWLF	4,334	2,191	2,100	9,159	3,667	0.23	0.49
Westmoreland (Rostraver) MWLF	8,730	8,472	-31	25,828	7,864	0.24	0.70
White Pines RWLF	6,647	5,903	1,693	18,301	4,044	2.19	6.03

a. Calculated assuming discharge to the lowest dilution river, creek or stream discharge.

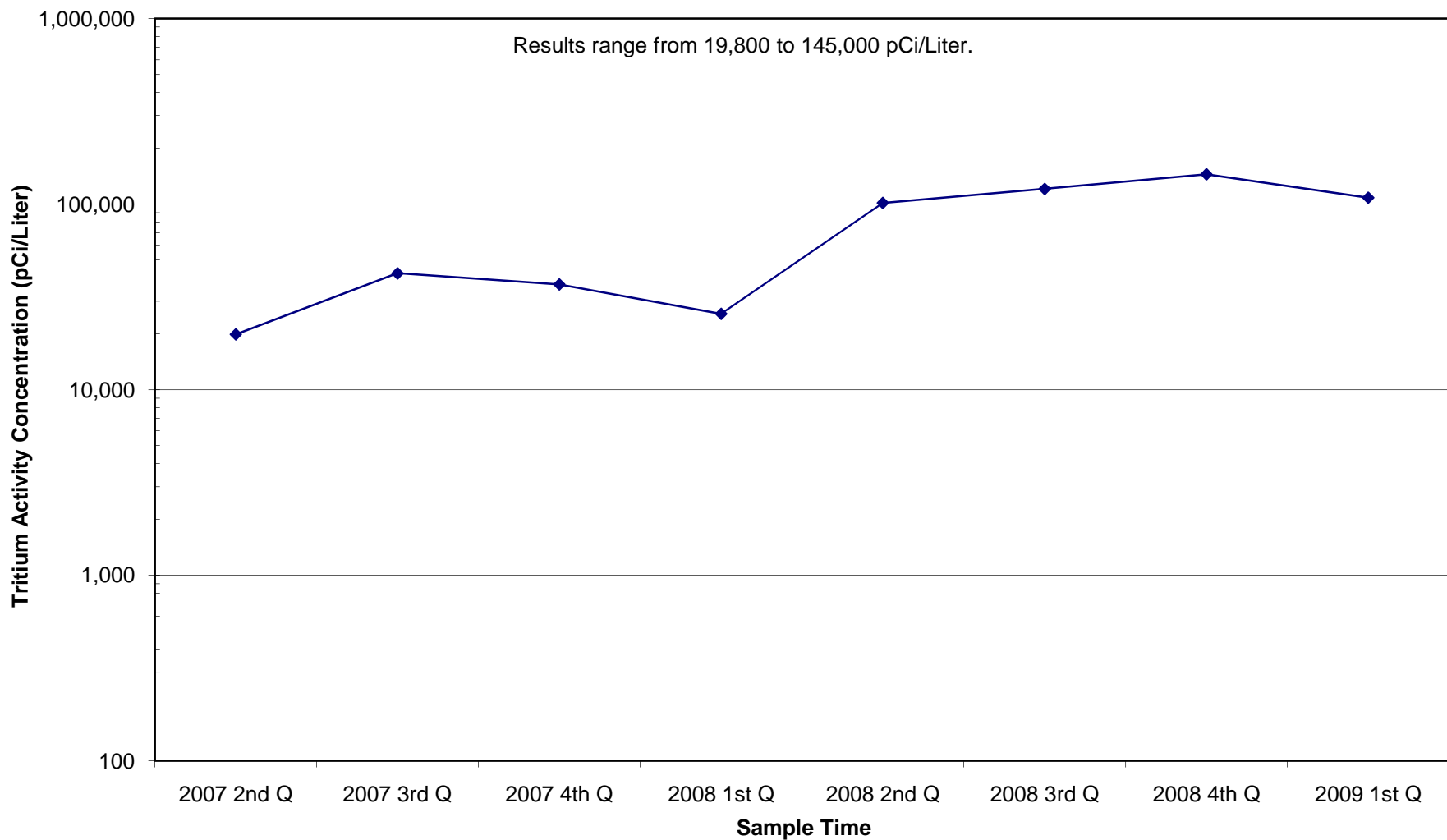
ND No discharge at present time

¹Analytical result is an outlier.

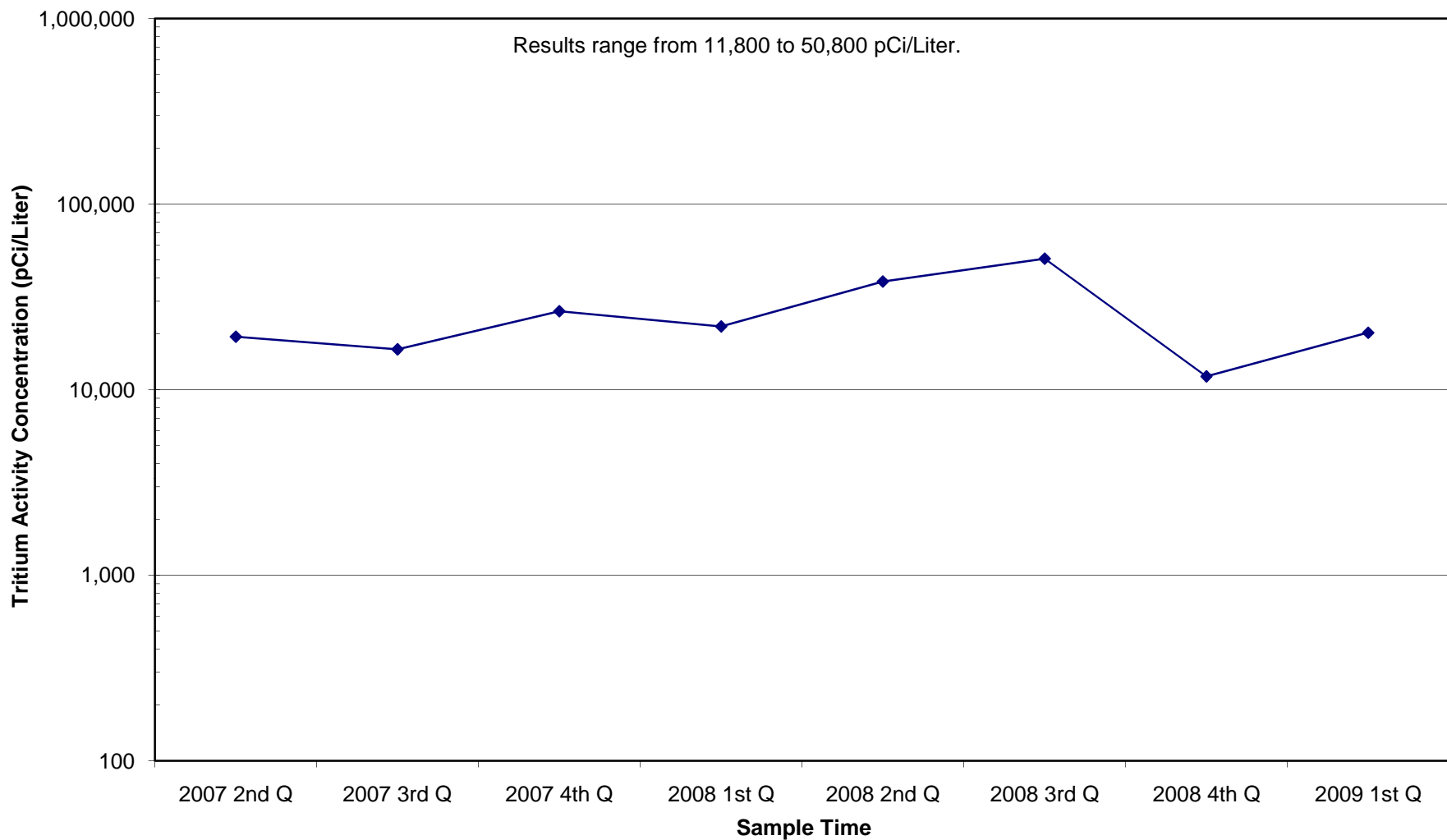
ATTACHMENT E

**INDIVIDUAL LANDFILL FACILITY TRITIUM CONCENTRATION GRAPHS
2007 THROUGH 2009**

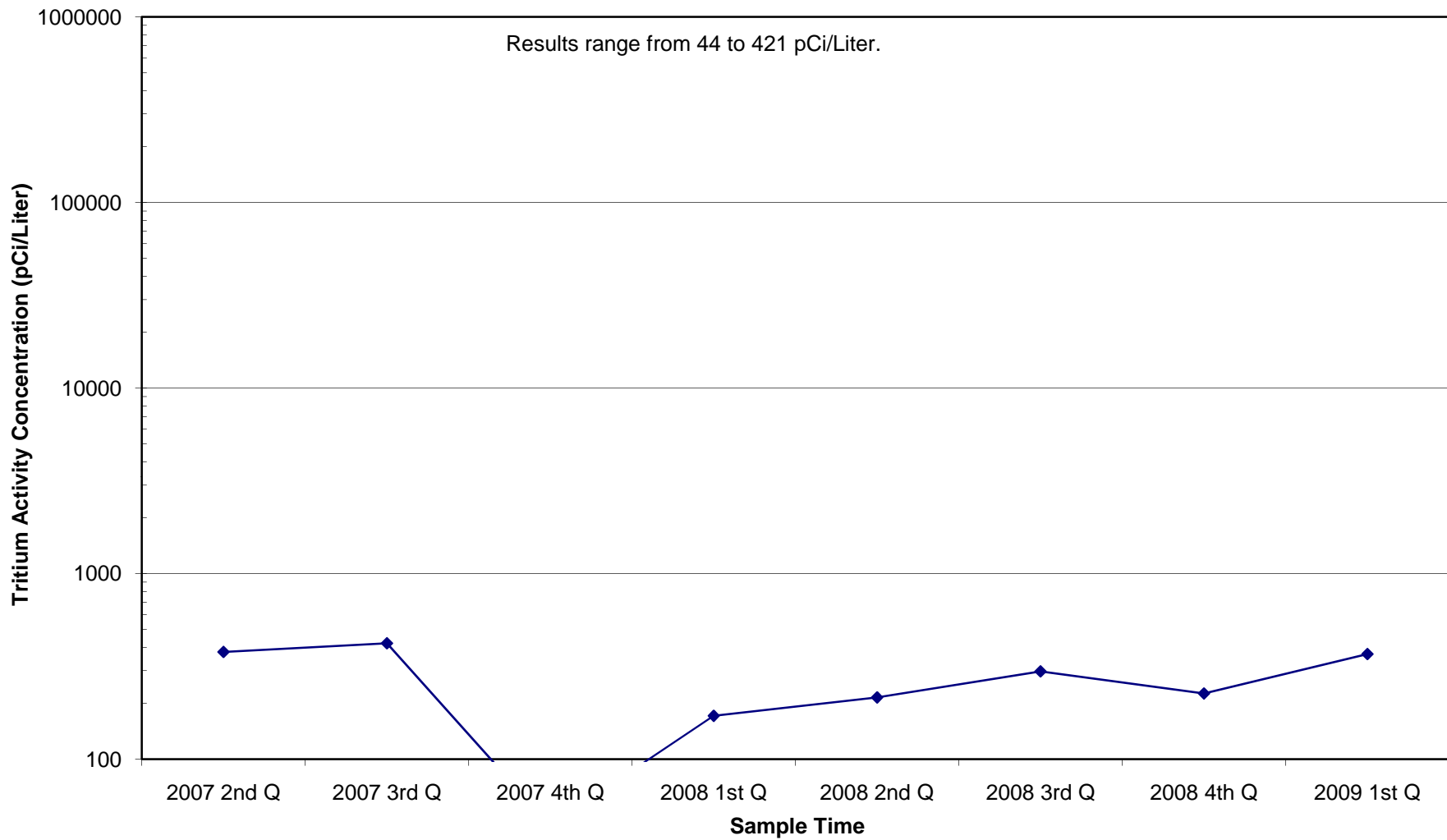
Alliance Sanitary Landfill Leachate Tritium Activity Concentration Trend



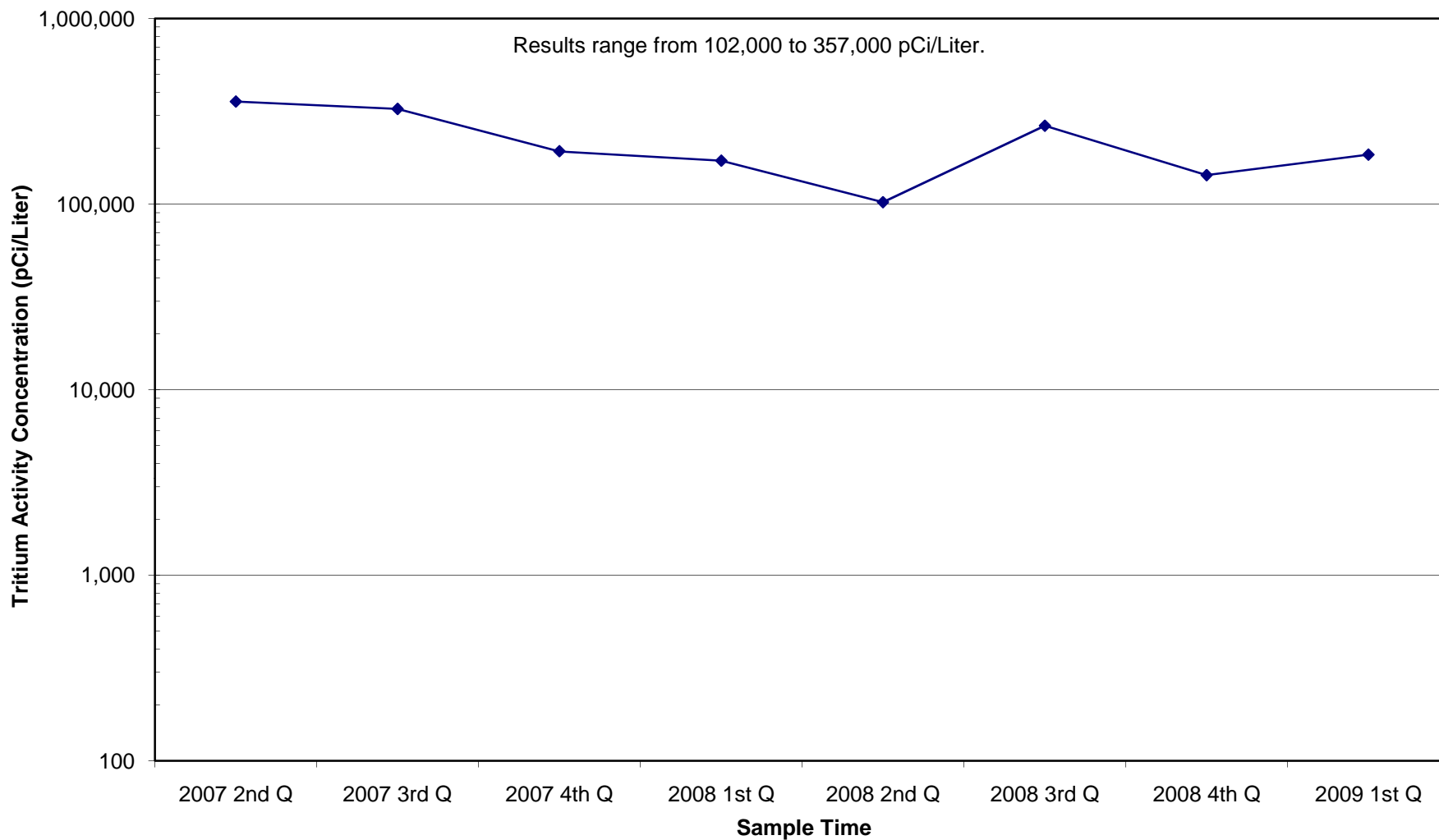
Arden Inc. Landfill Leachate Tritium Activity Concentration Trend



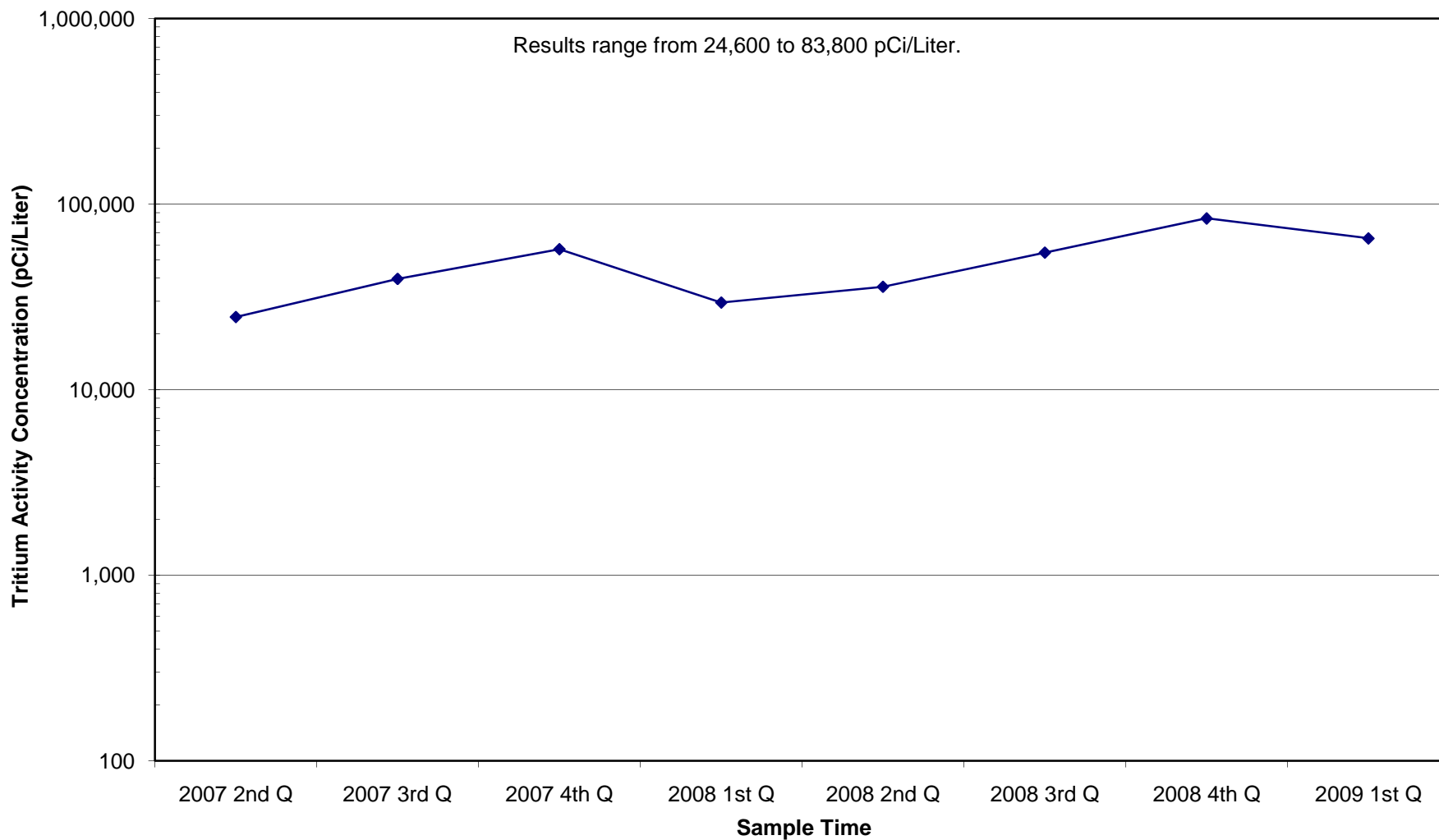
Bethlehem Steel Corp. Landfill Leachate Tritium Activity Concentration Trend



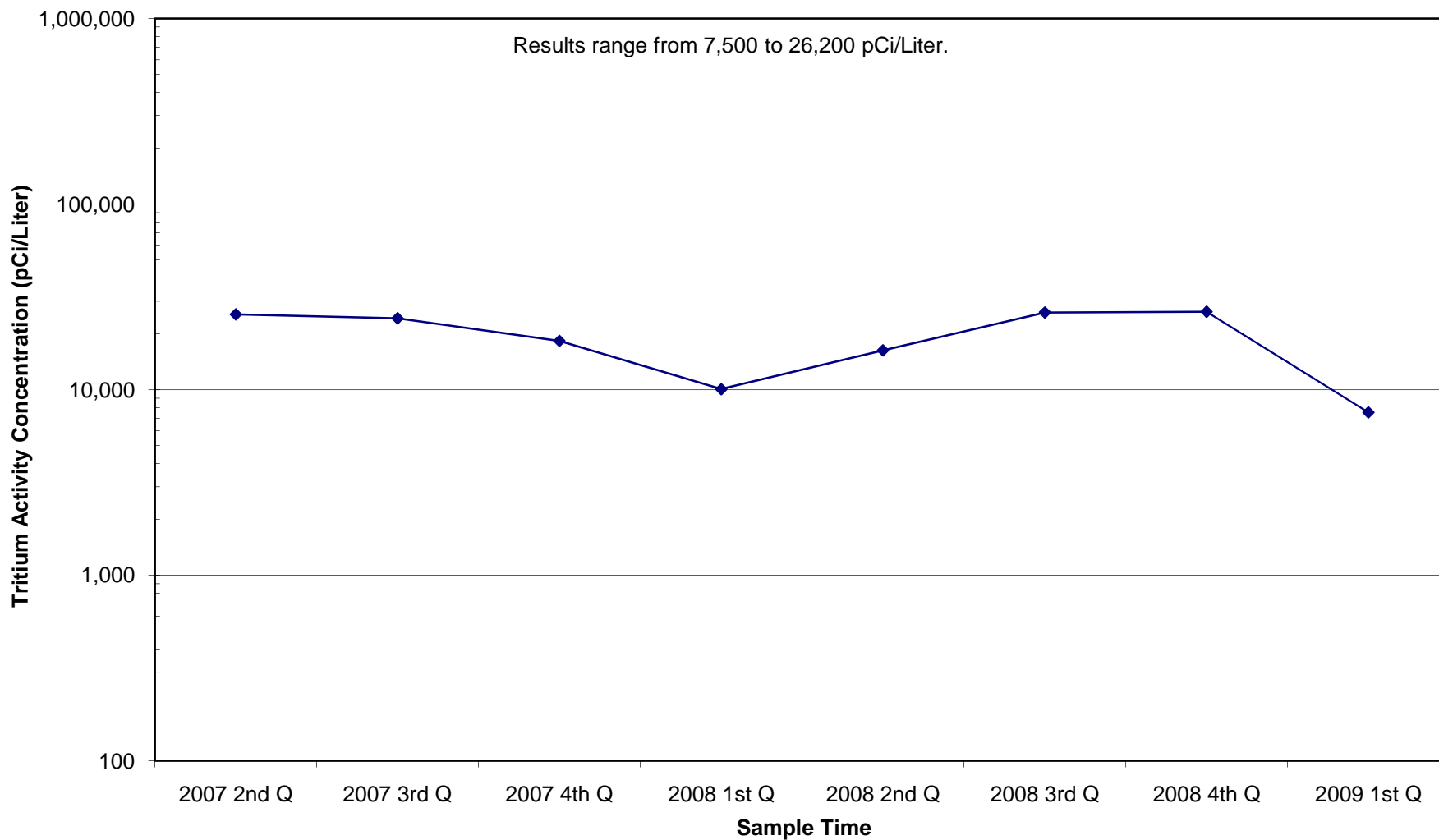
BFI Conestoga Landfill Leachate Tritium Activity Concentration Trend



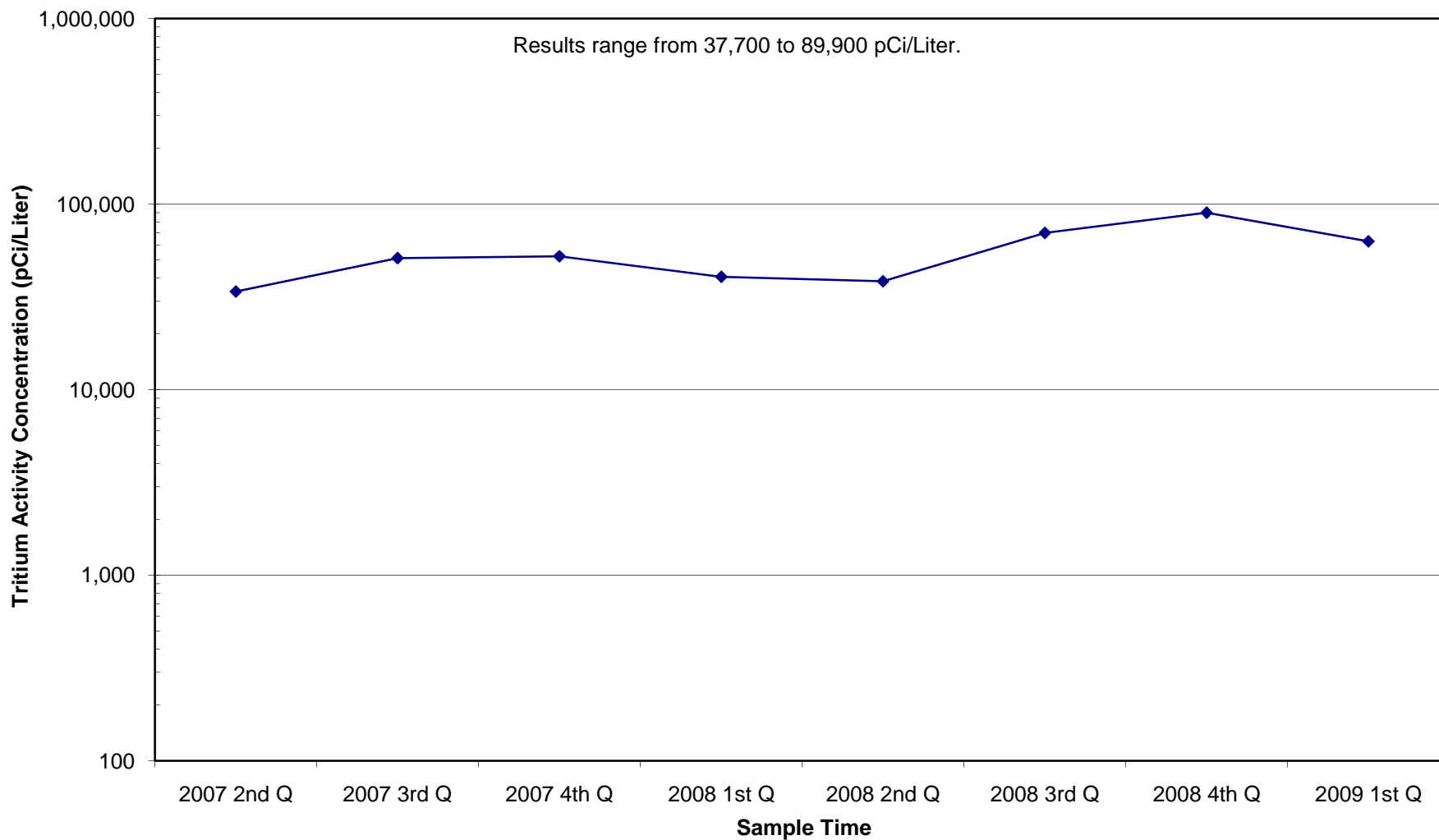
BFI Imperial Landfill Leachate Tritium Activity Concentration Trend



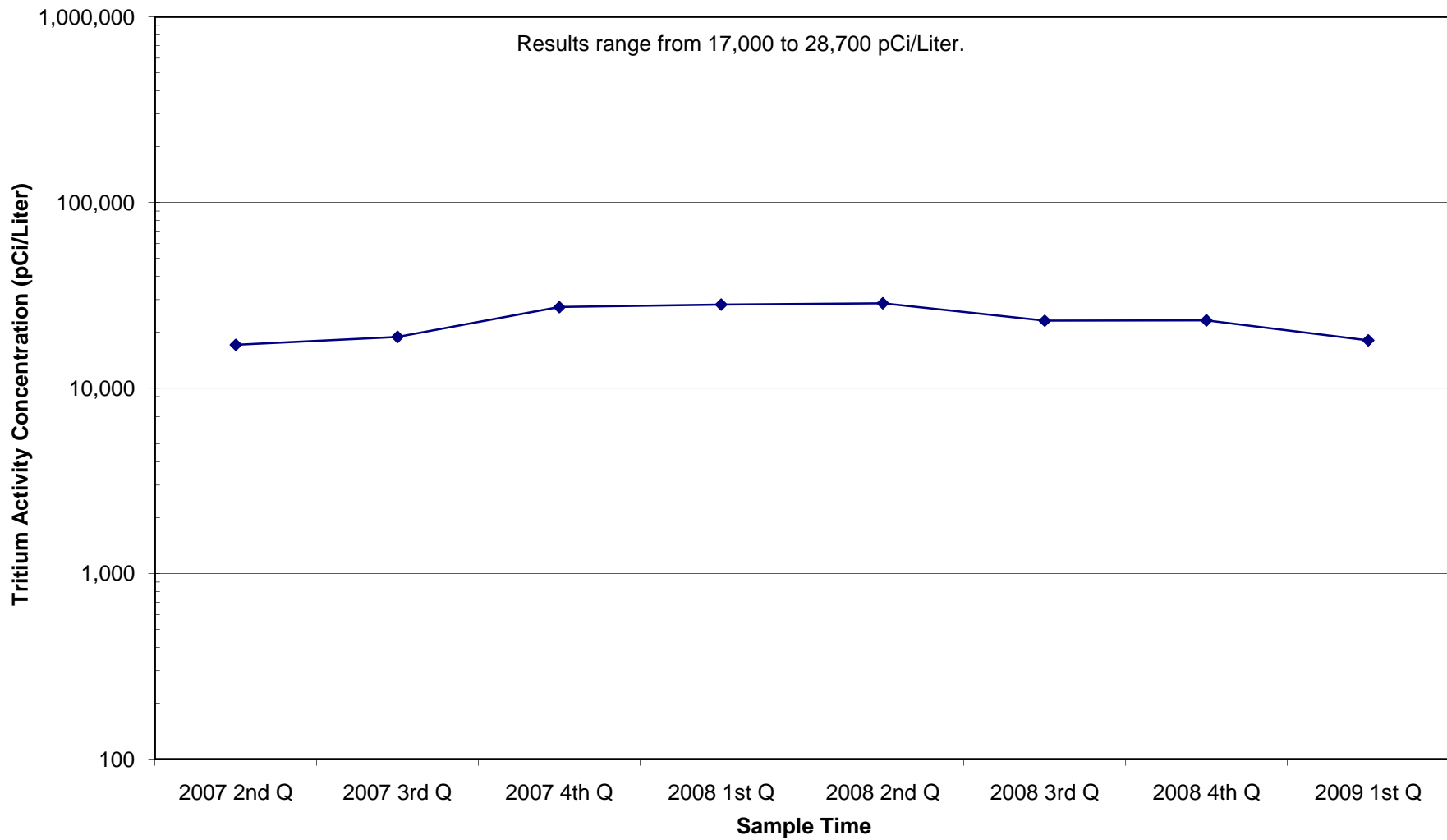
Brunner Landfill Leachate Tritium Activity Concentration Trend



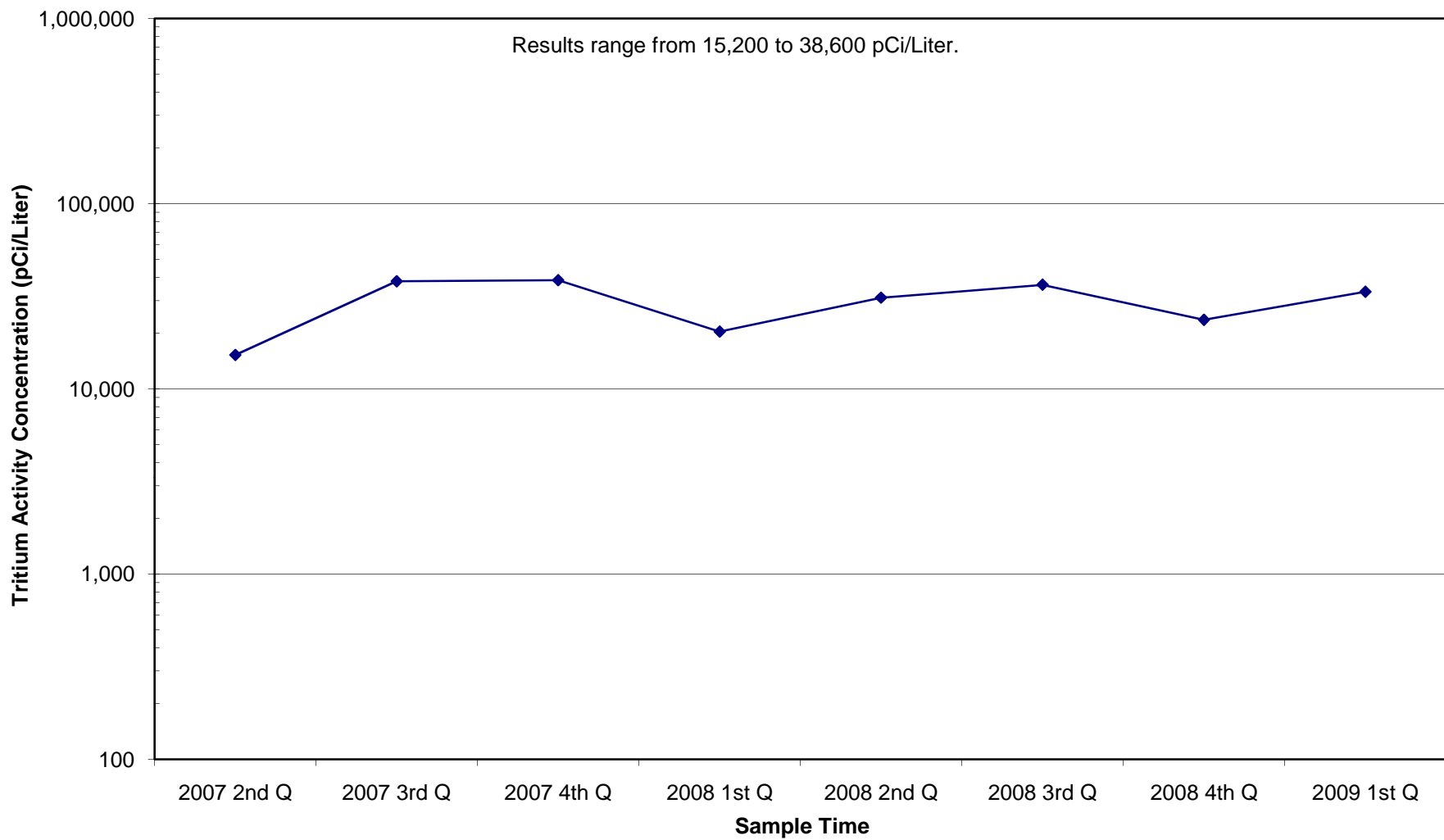
Chrin Brothers, Inc. Landfill Leachate Tritium Activity Concentration Trend



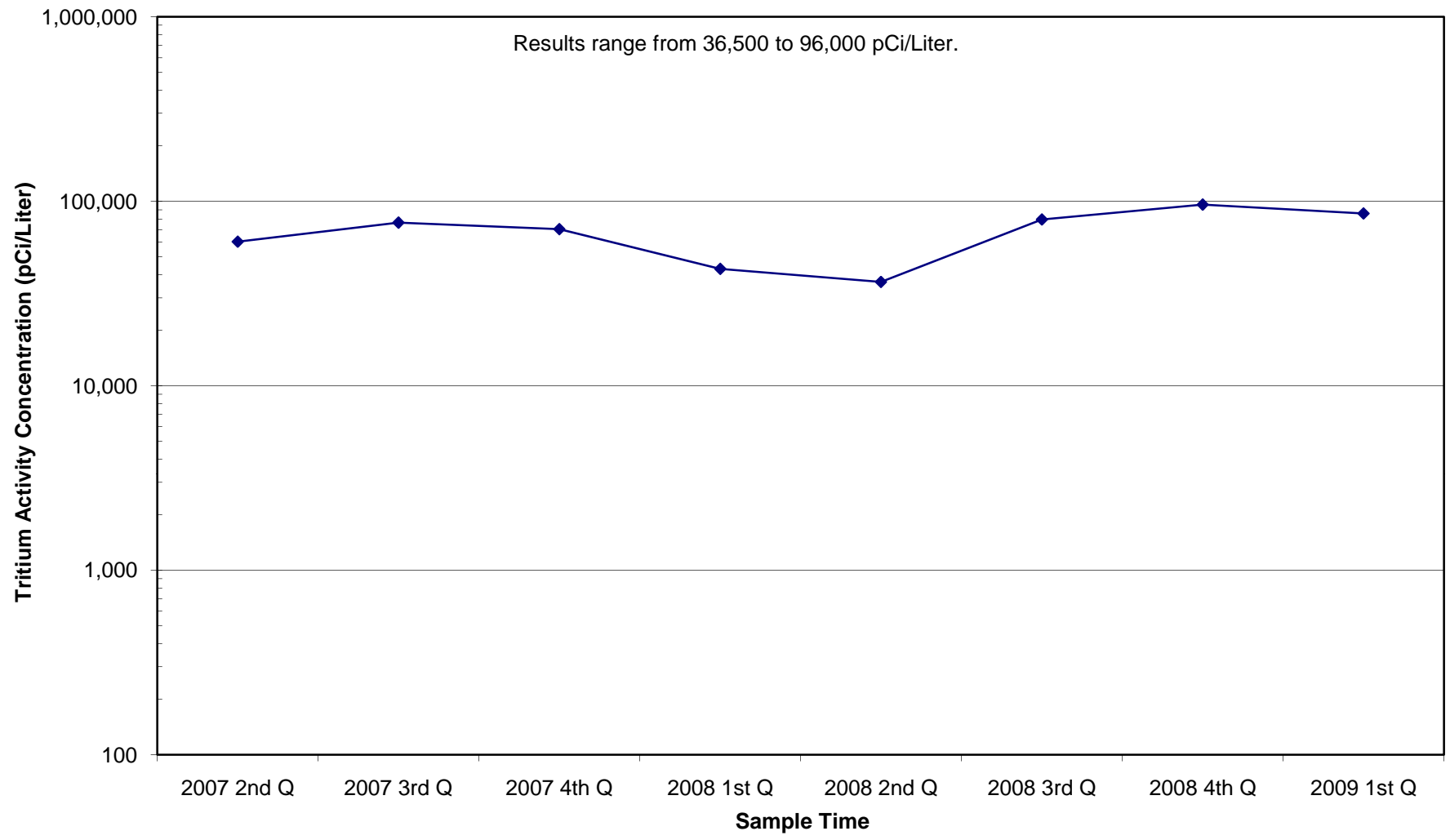
Clarion County Landfill Leachate Tritium Activity Concentration Trend



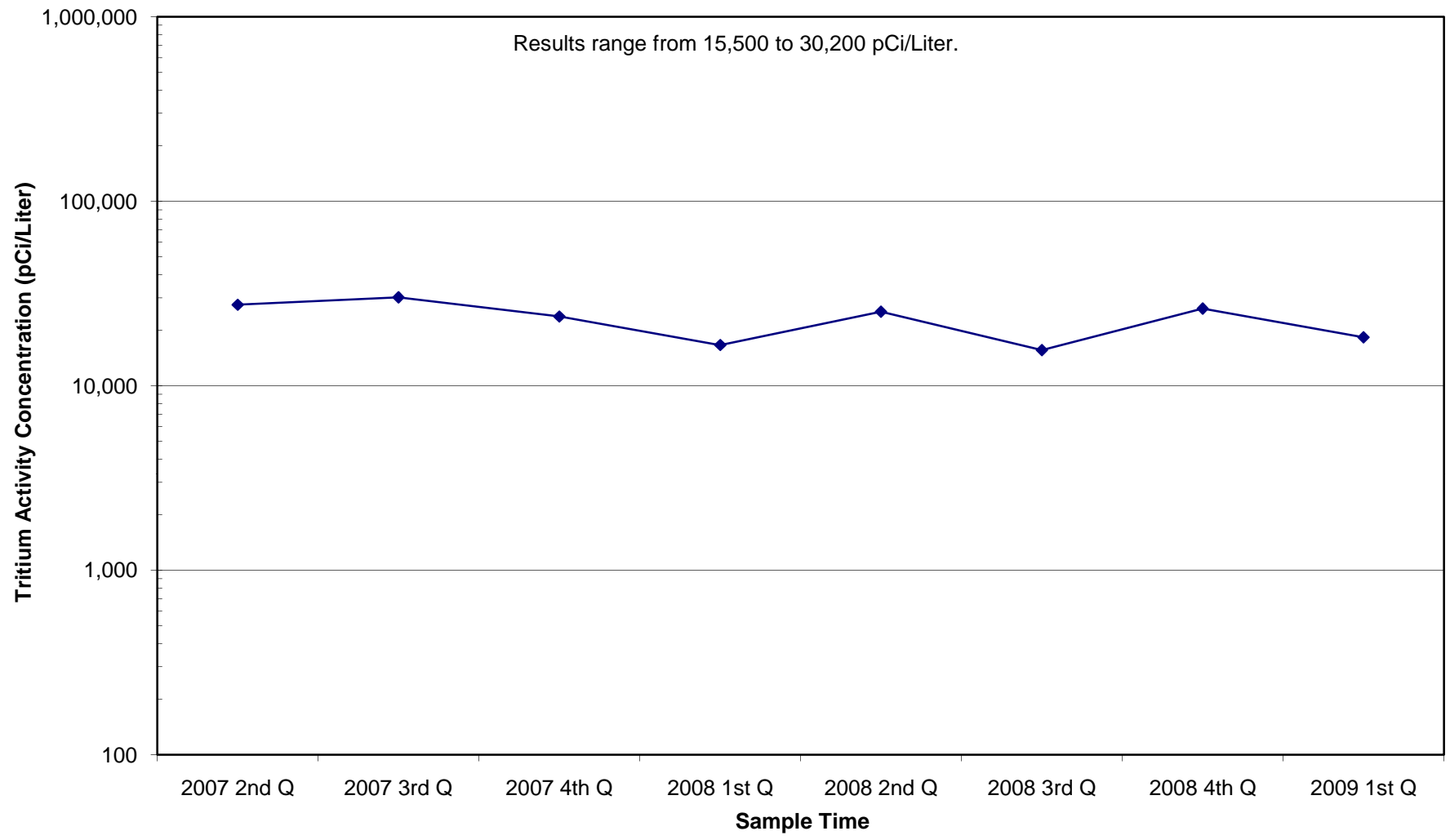
Commonwealth Env Sys Landfill Leachate Tritium Activity Concentration Trend



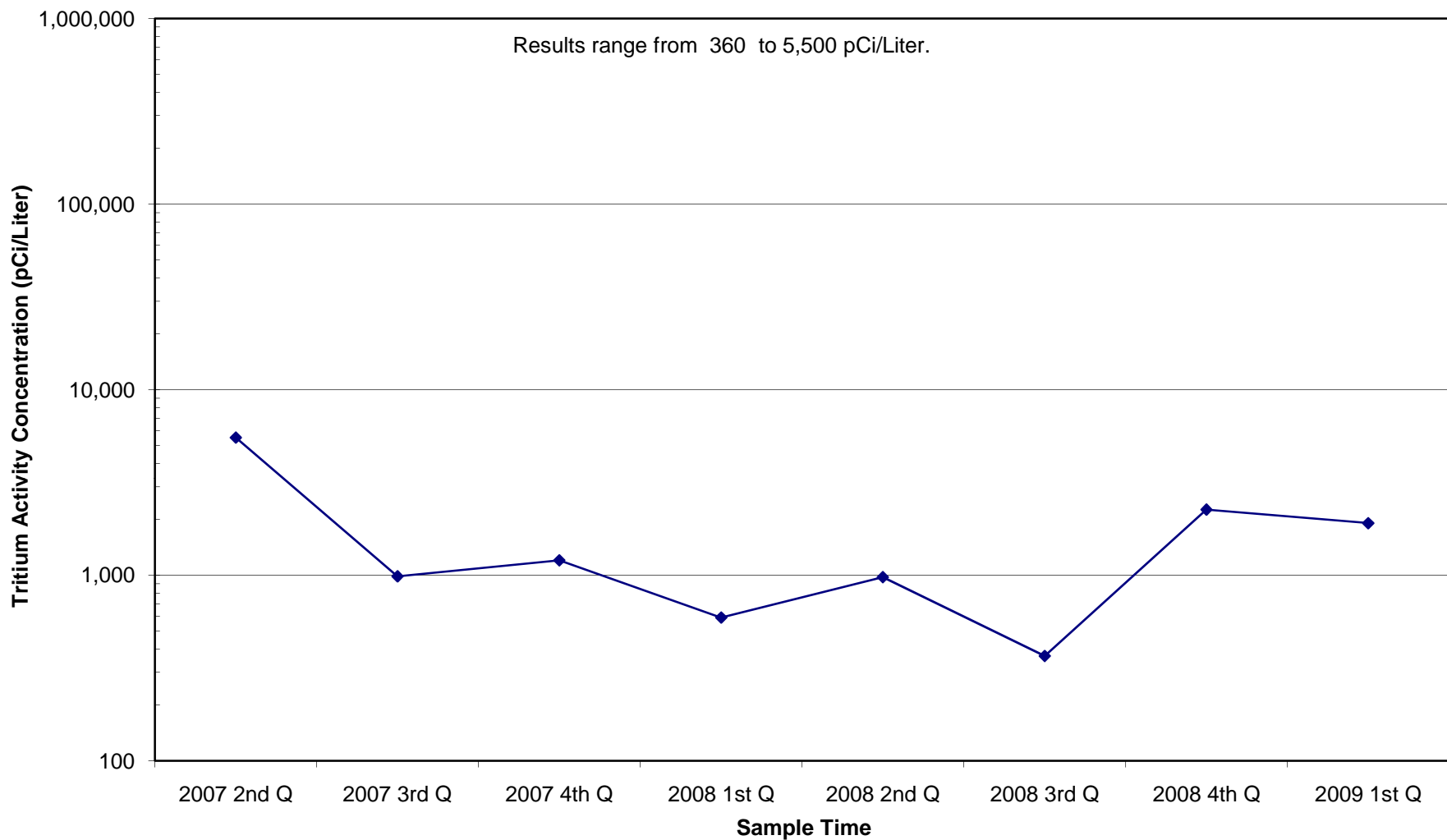
Cumberland Landfill Leachate Tritium Activity Concentration Trend



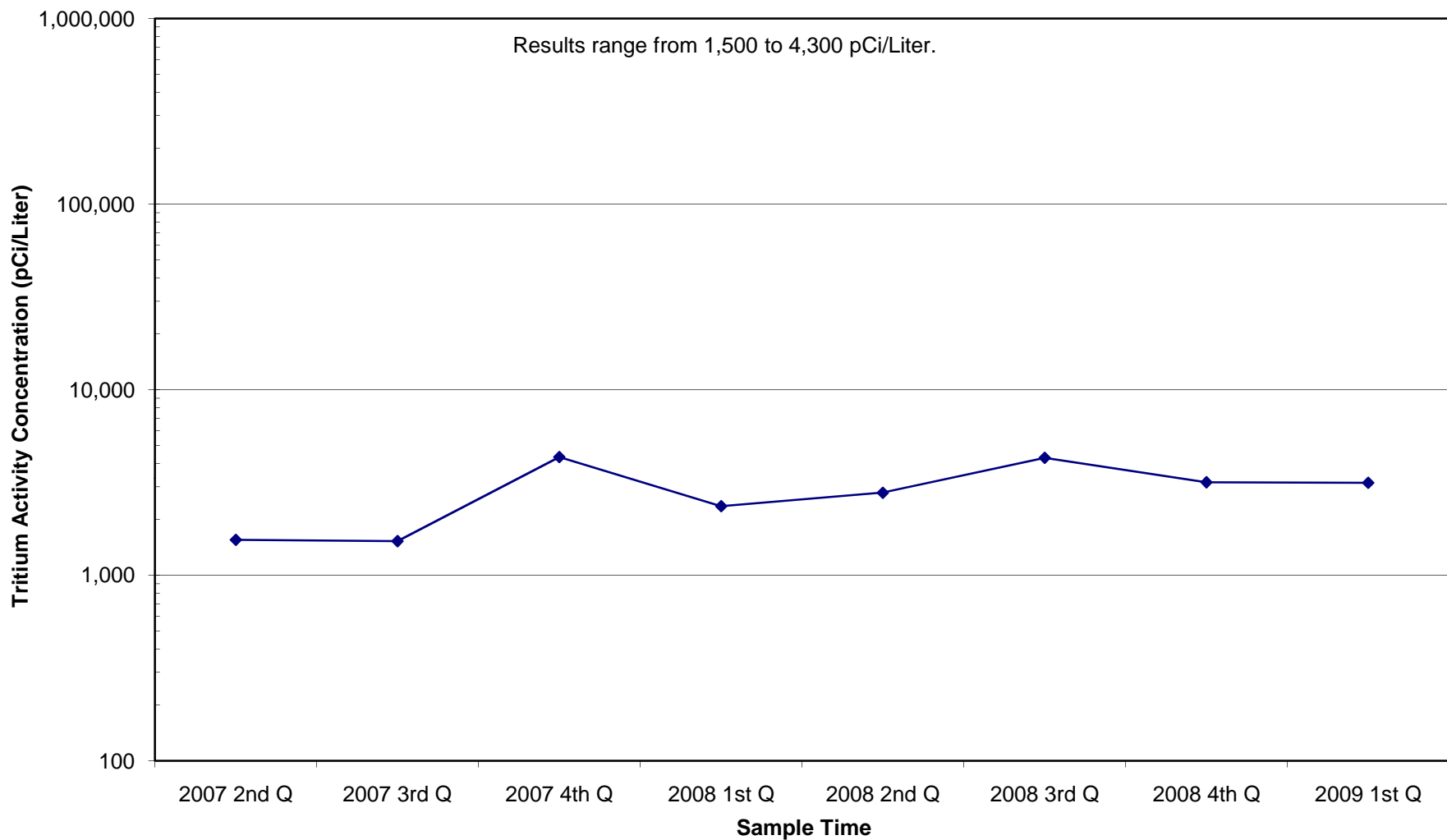
DCSWA (Rolling Hills) Landfill Leachate Tritium Activity Concentration Trend



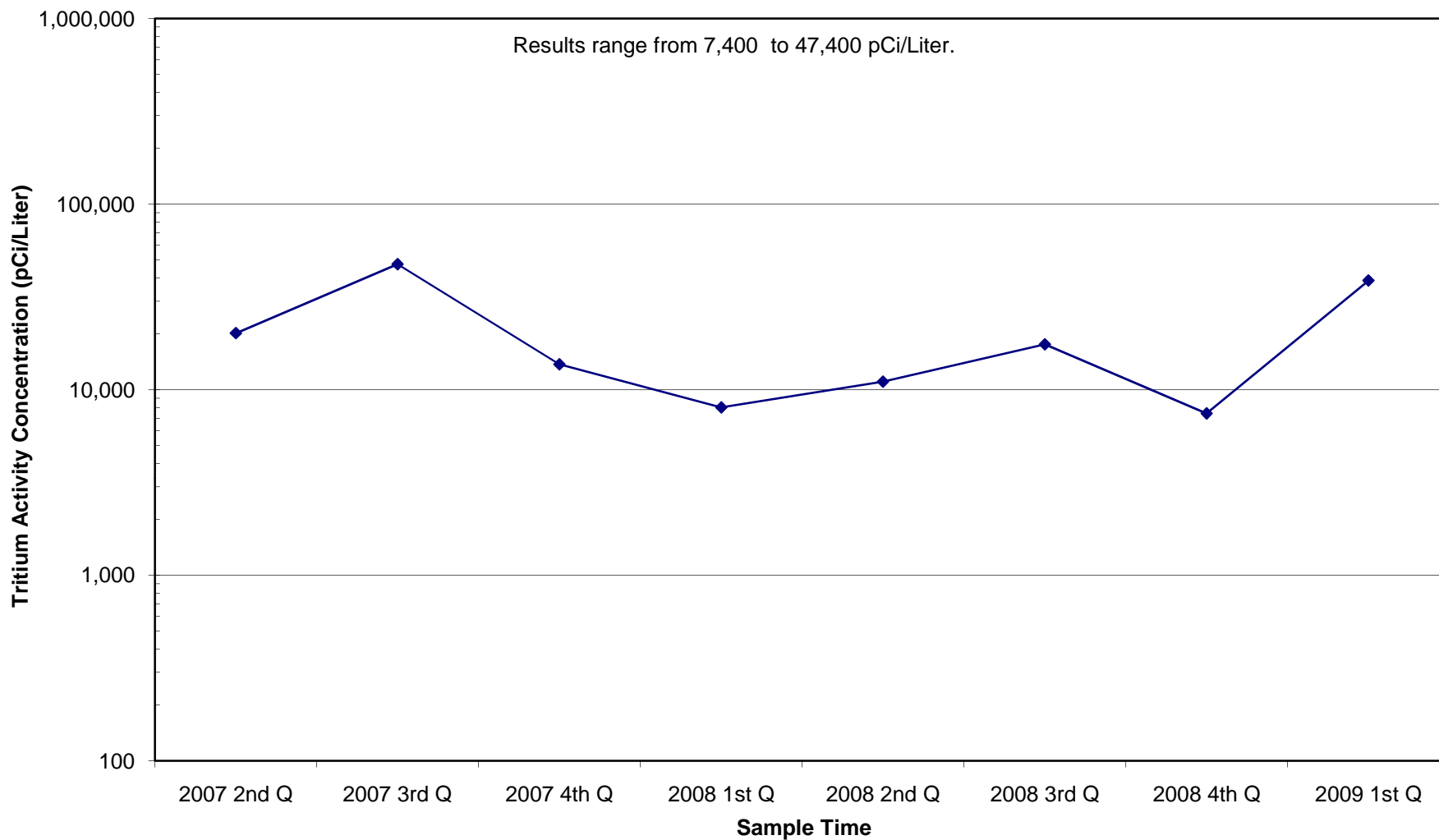
Deep Valley C & D Landfill Leachate Tritium Activity Concentration Trend



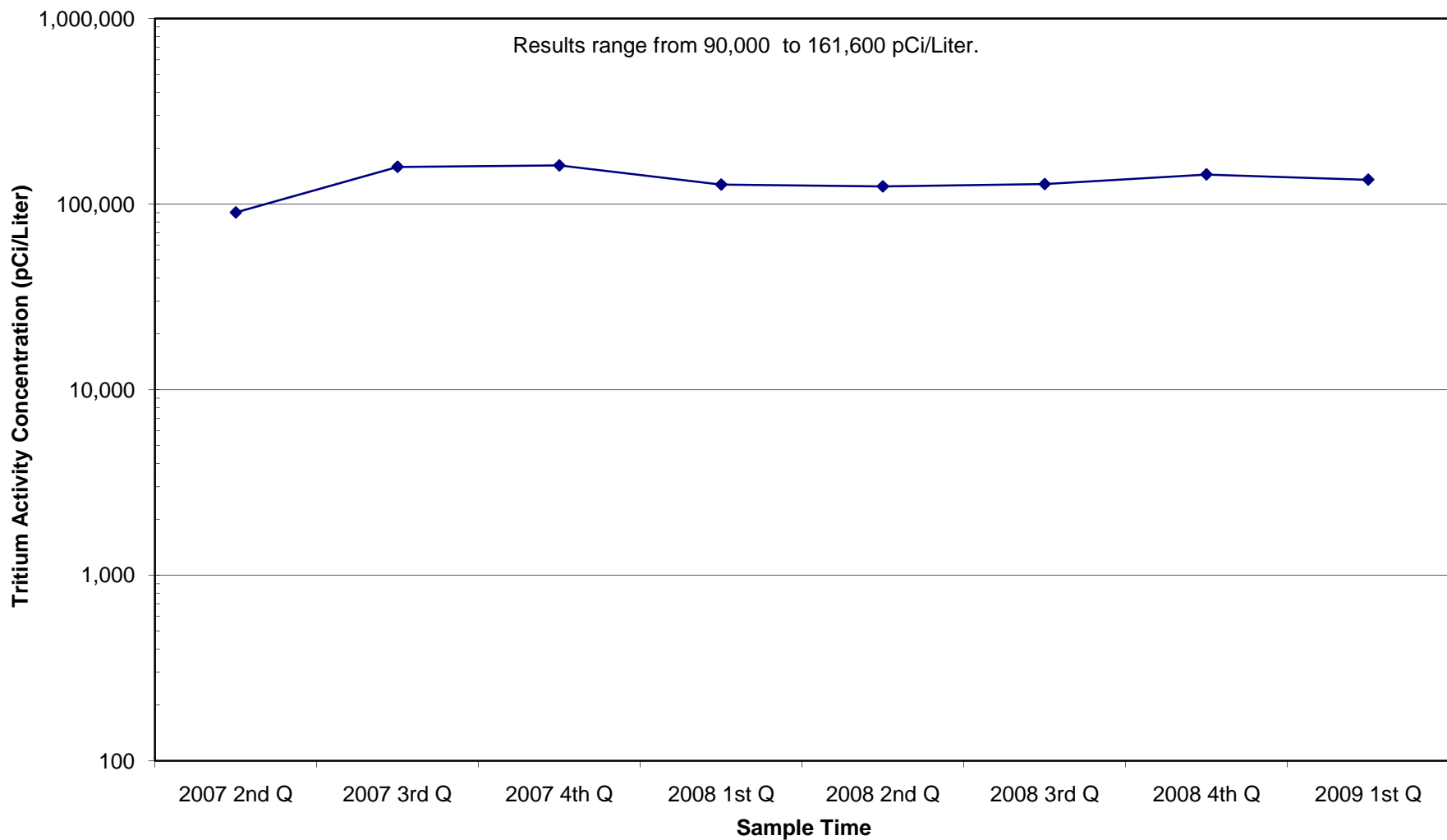
Evergreen Landfill Leachate Tritium Activity Concentration Trend



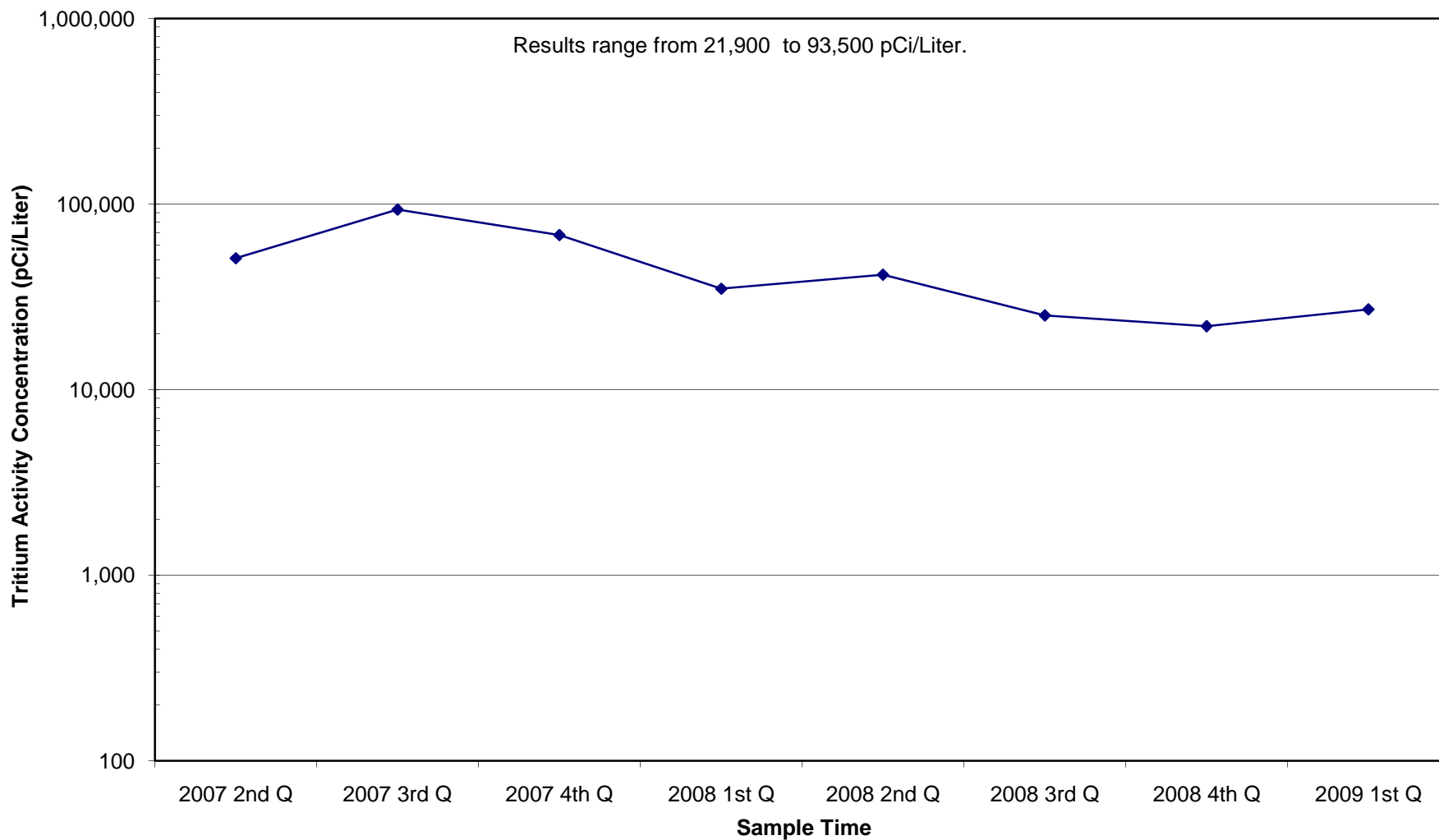
GLRA Landfill Leachate Tritium Activity Concentration Trend



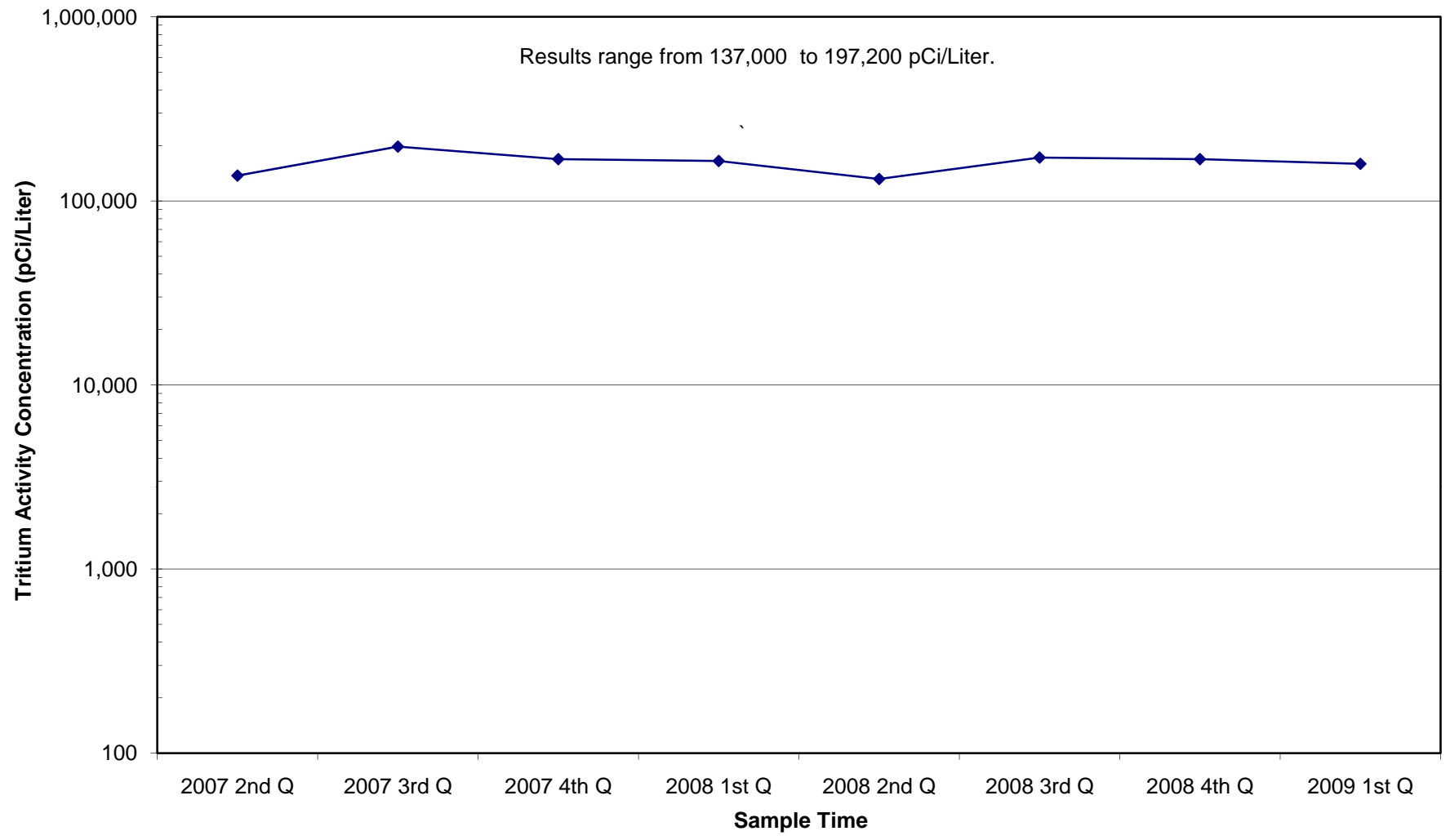
Grand Central Sanitary Landfill Leachate Tritium Activity Concentration Trend



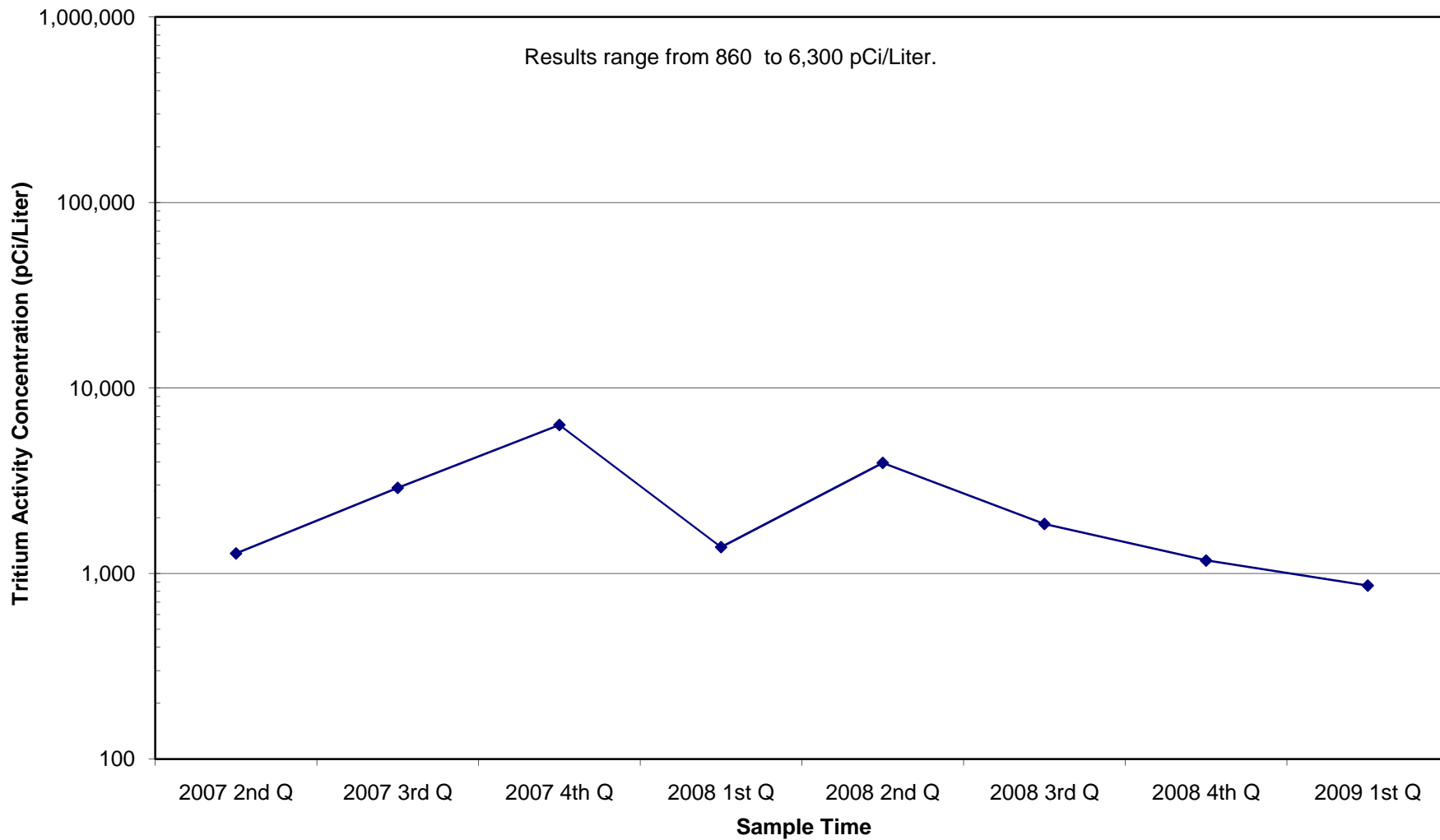
Greenridge Reclamation Landfill Leachate Tritium Activity Concentration Trend



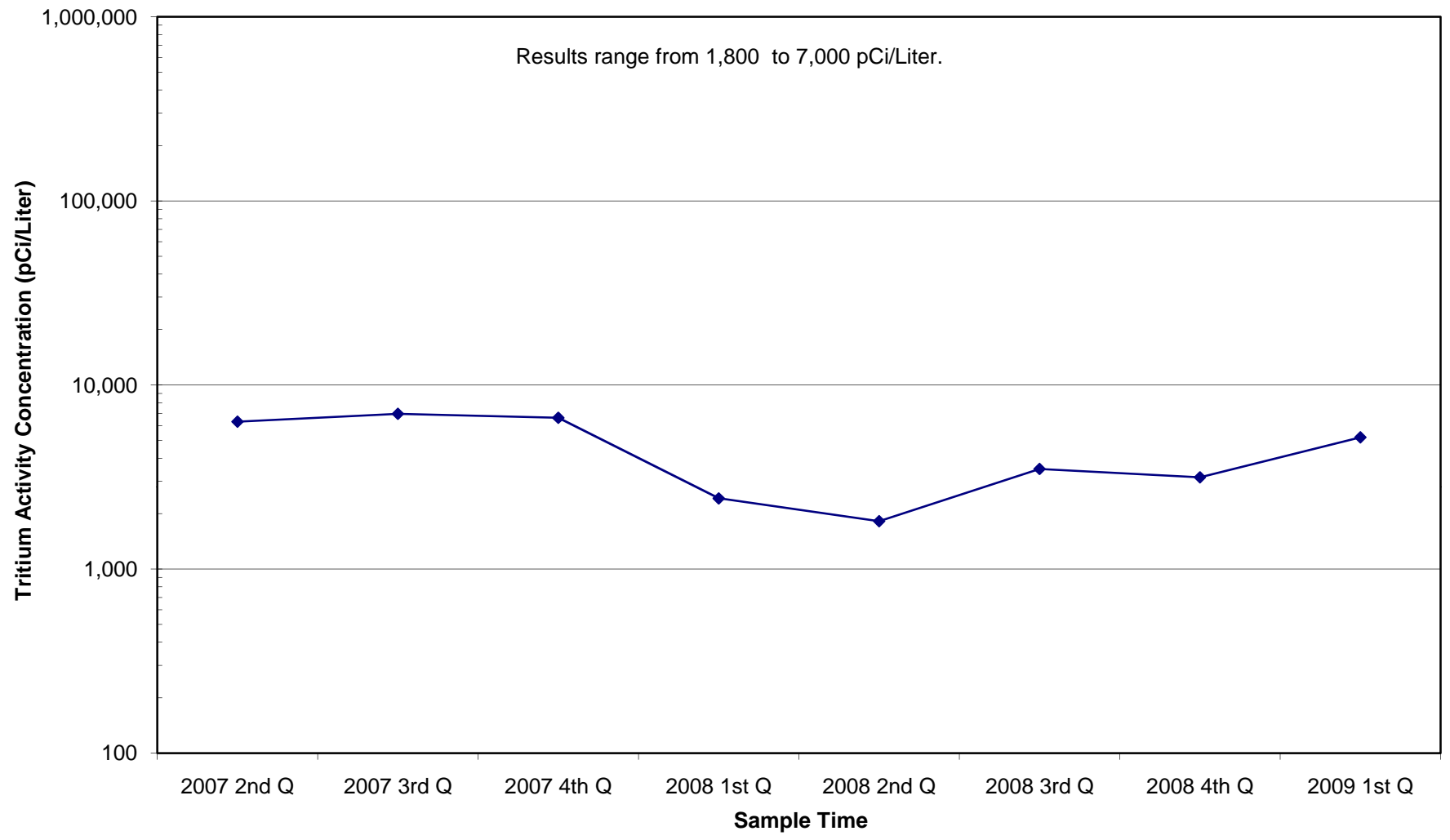
GROWS Landfill Leachate Tritium Activity Concentration Trend



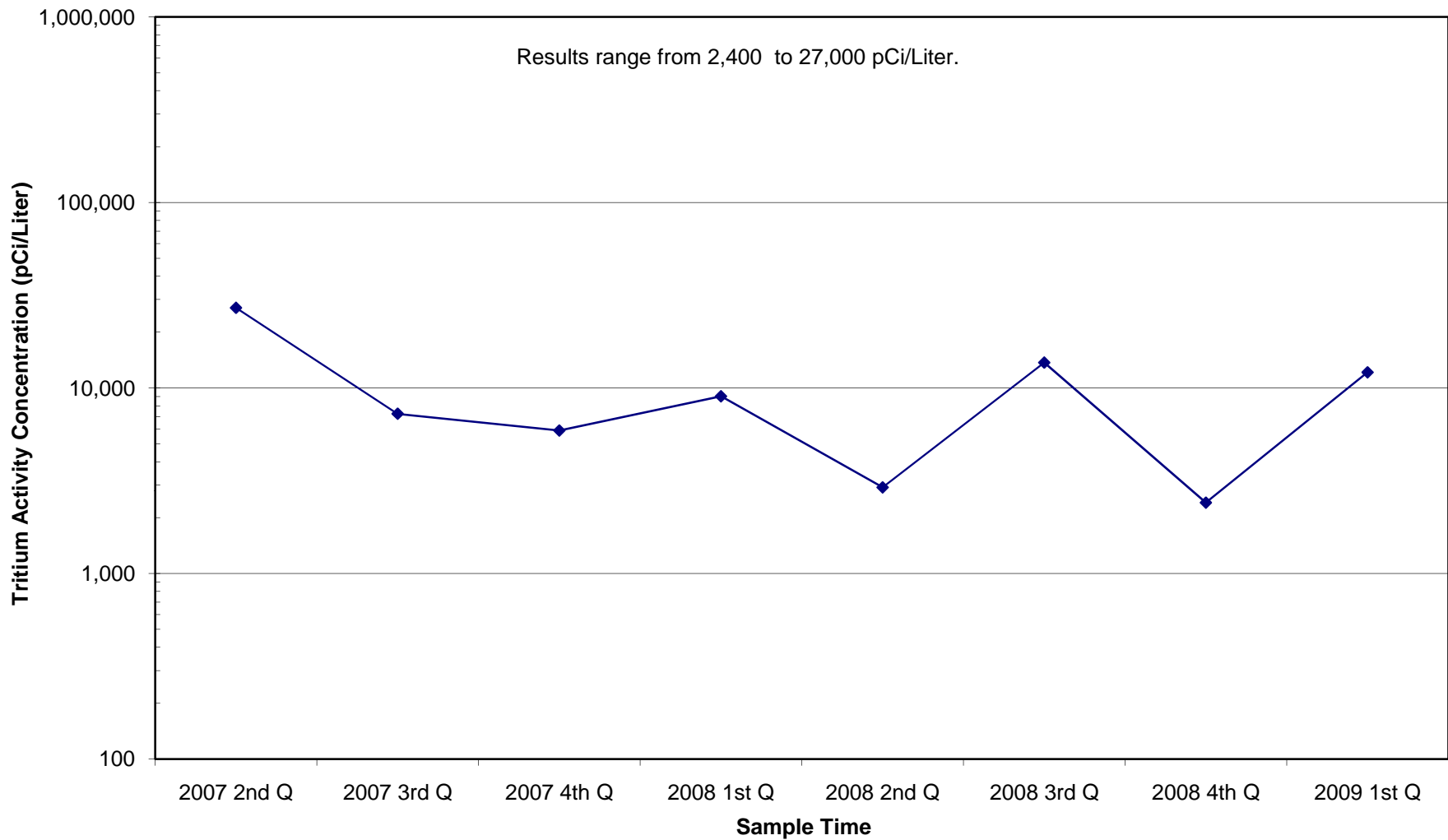
IESI Bethlehem Landfill Leachate Tritium Activity Concentration Trend



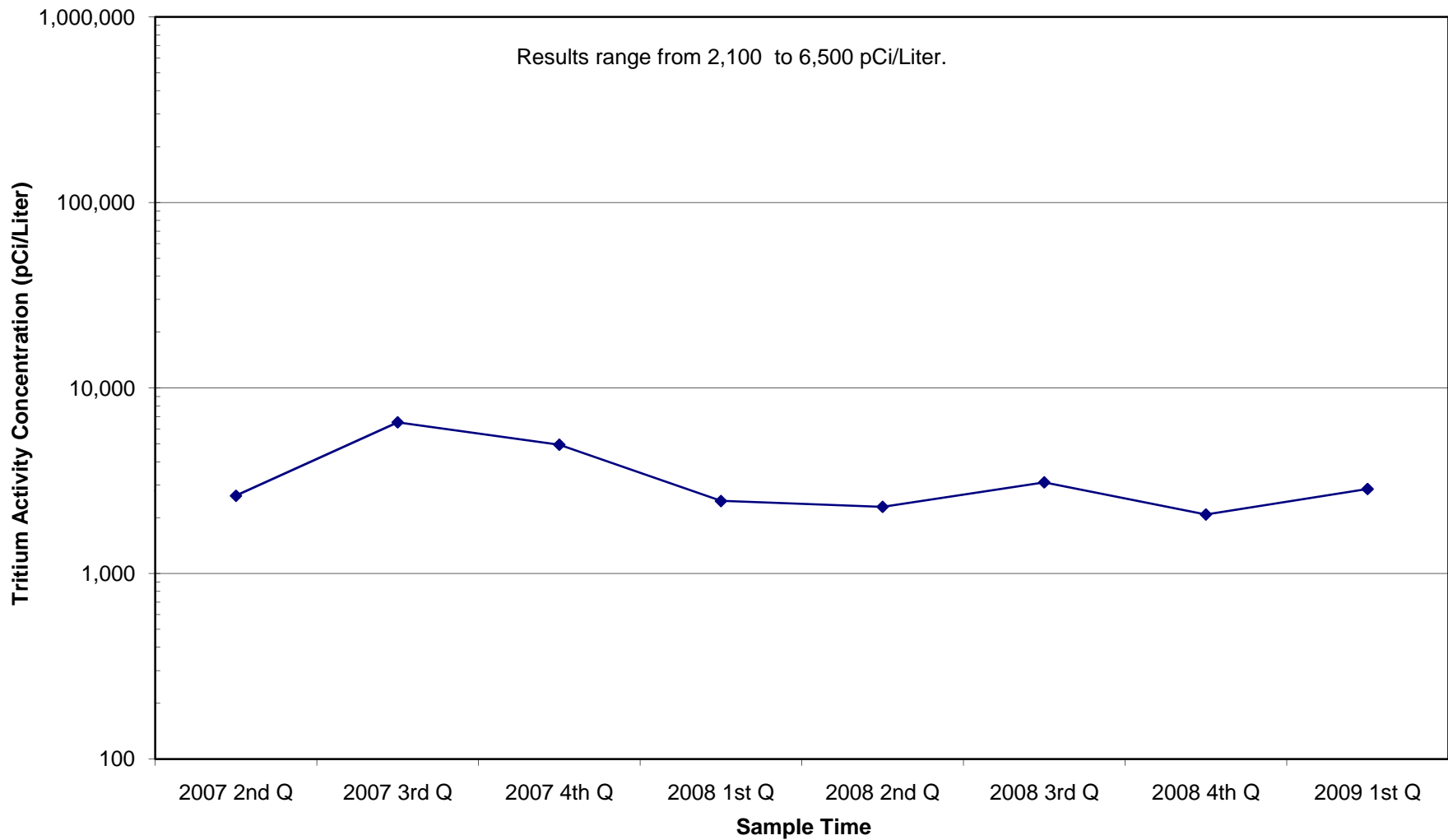
IESI Blue Ridge Landfill Leachate Tritium Activity Concentration Trend



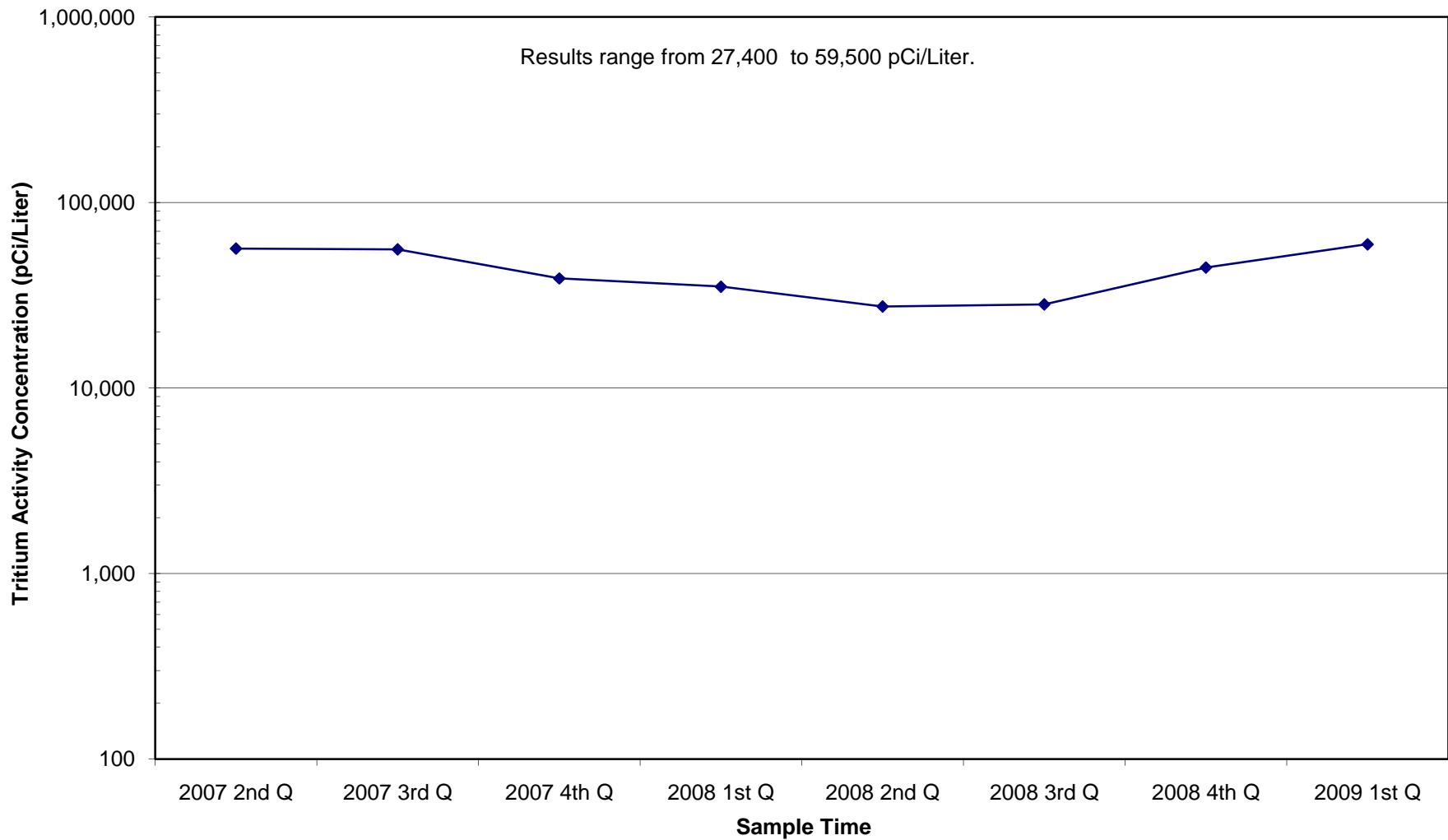
J & J (Chestnut) Landfill Leachate Tritium Activity Concentration Trend



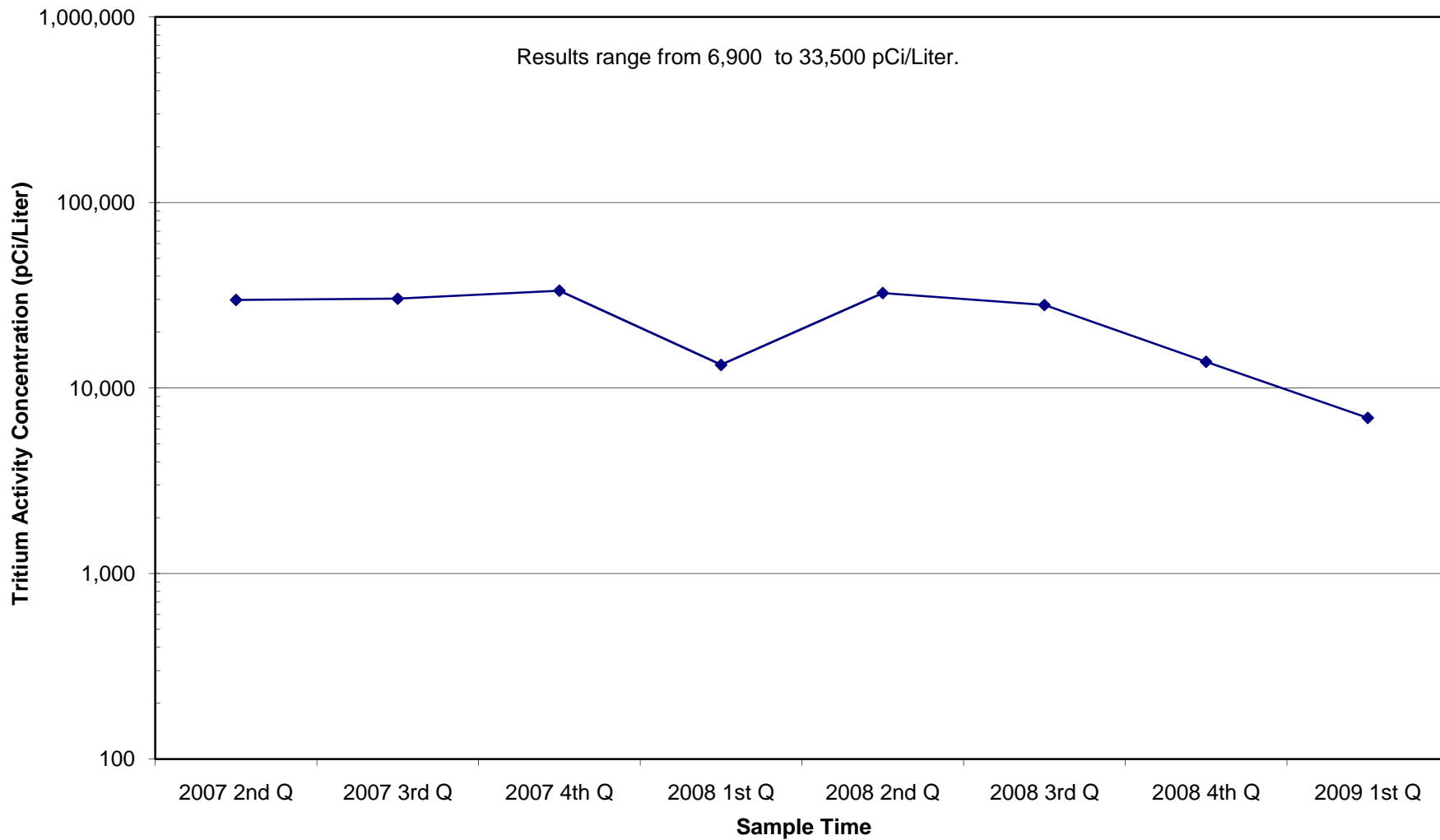
Kelly Run Sanitation Landfill Leachate Tritium Activity Concentration Trend



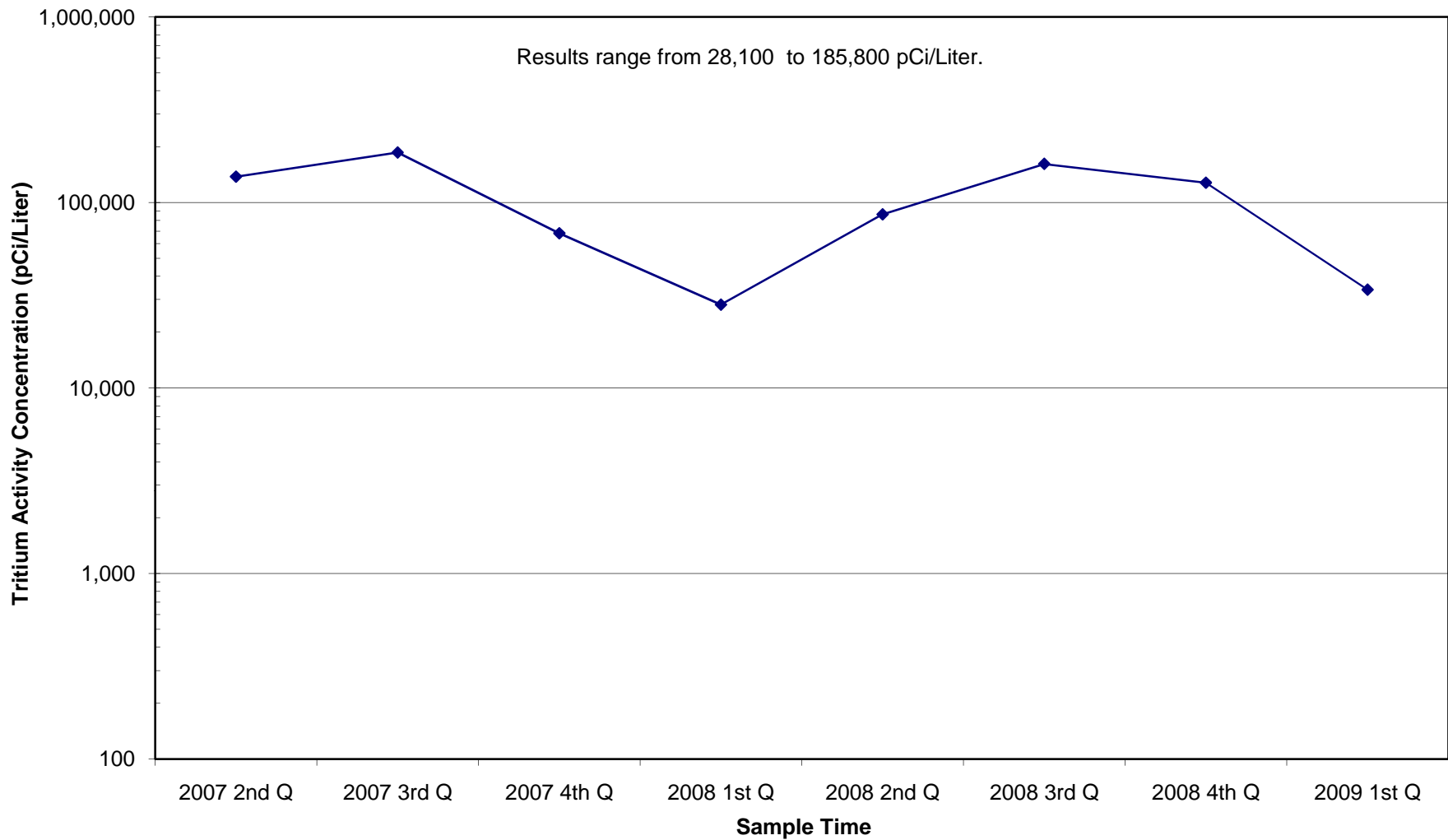
Keystone Sanitary Landfill Leachate Tritium Activity Concentration Trend



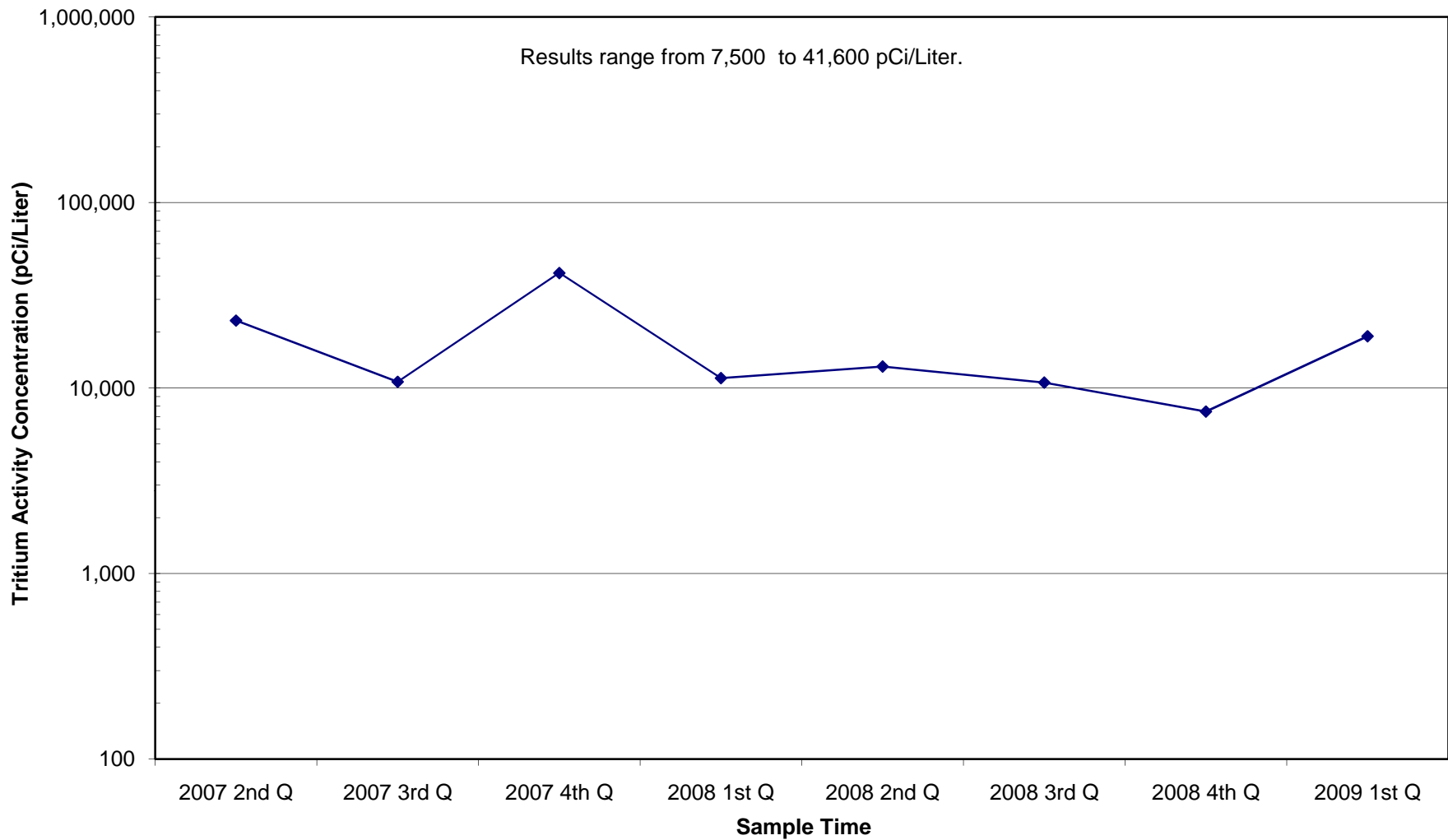
Lake View Landfill Leachate Tritium Activity Concentration Trend



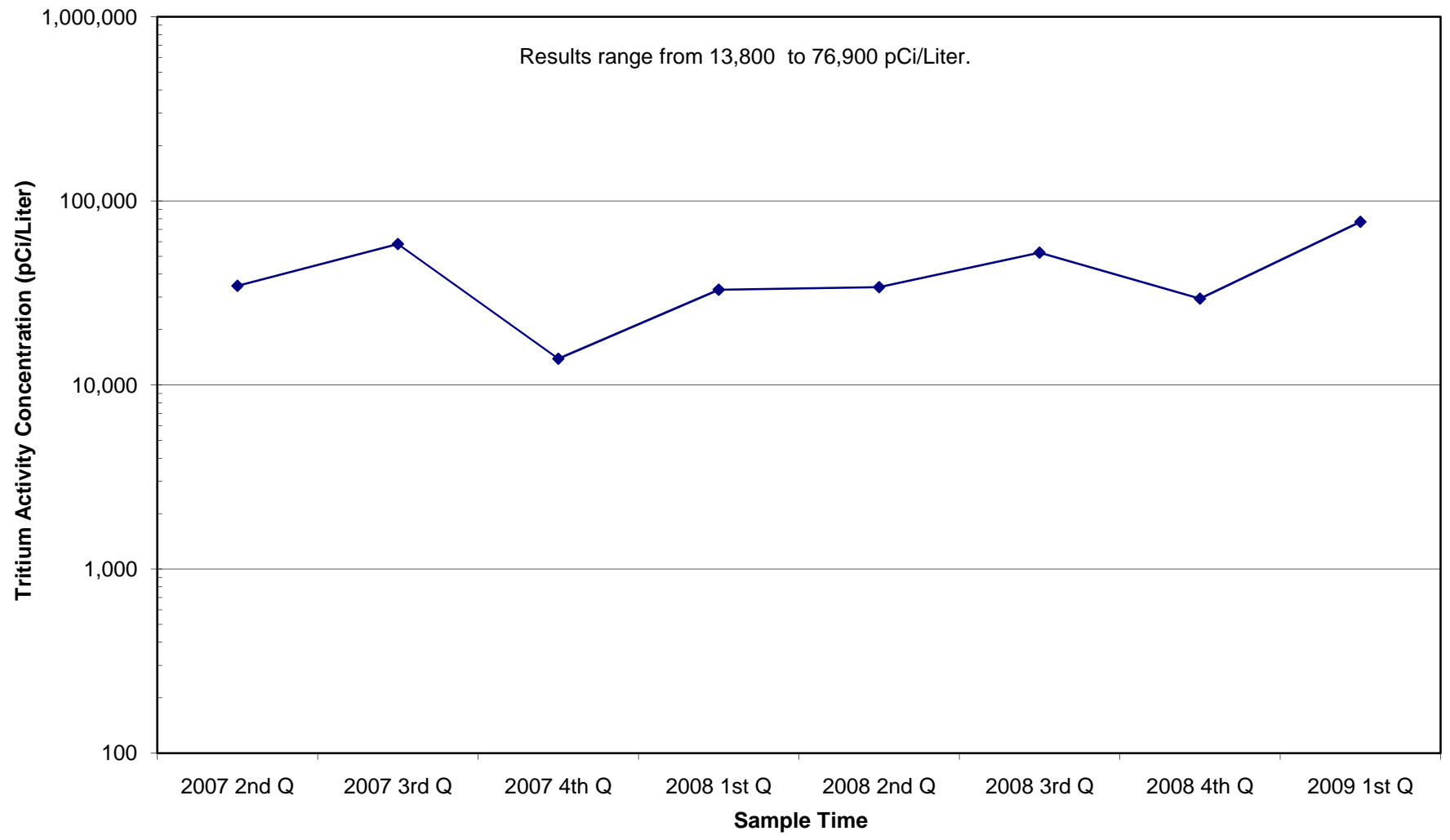
Lanchester Landfill Leachate Tritium Activity Concentration Trend



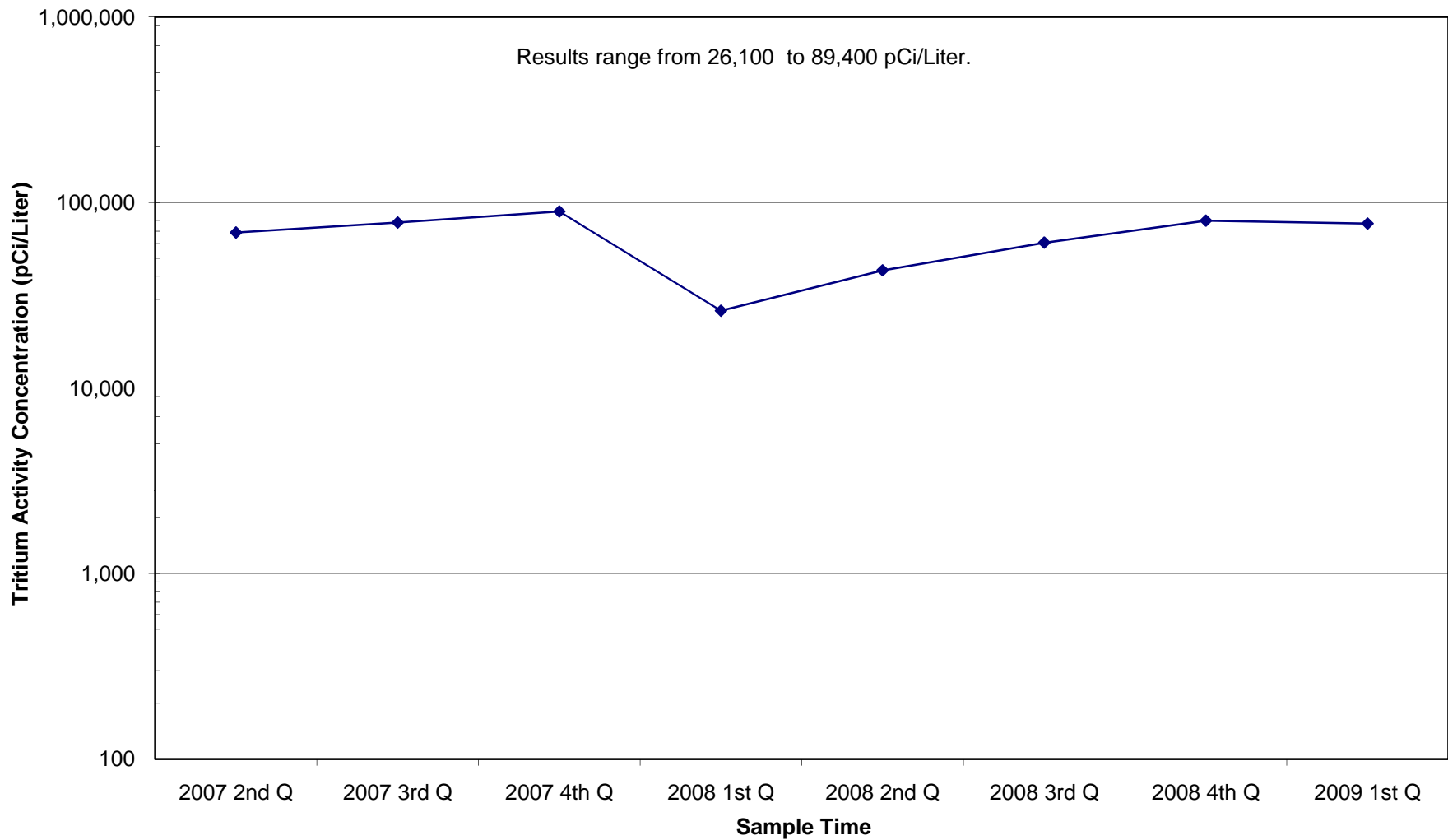
Laurel Highland Landfill Leachate Tritium Activity Concentration Trend



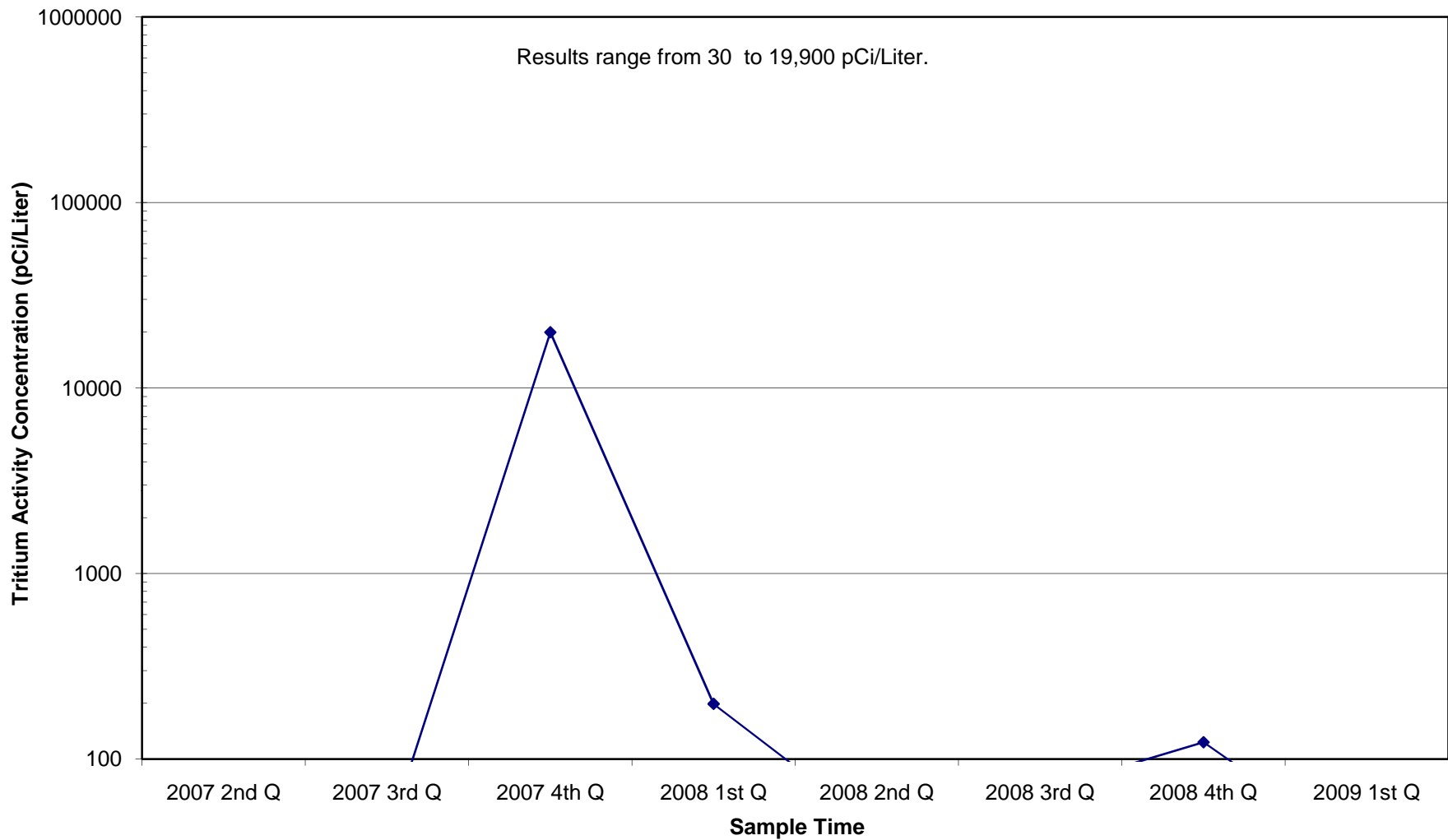
LCSWMA (Frey Farm) Landfill Leachate Tritium Activity Concentration Trend



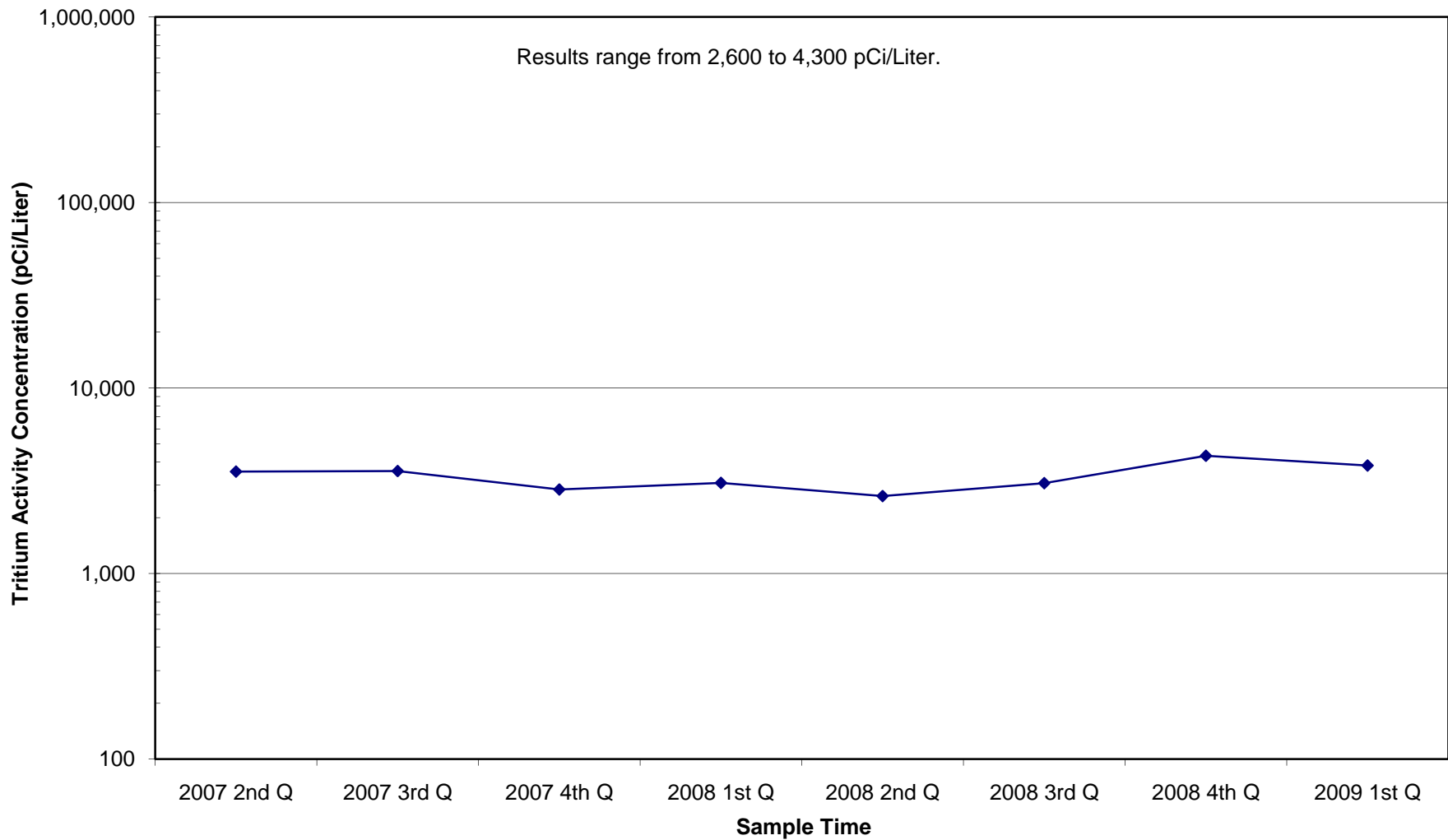
Lycoming Co (Allenwood) Landfill Leachate Tritium Activity Concentration Trend



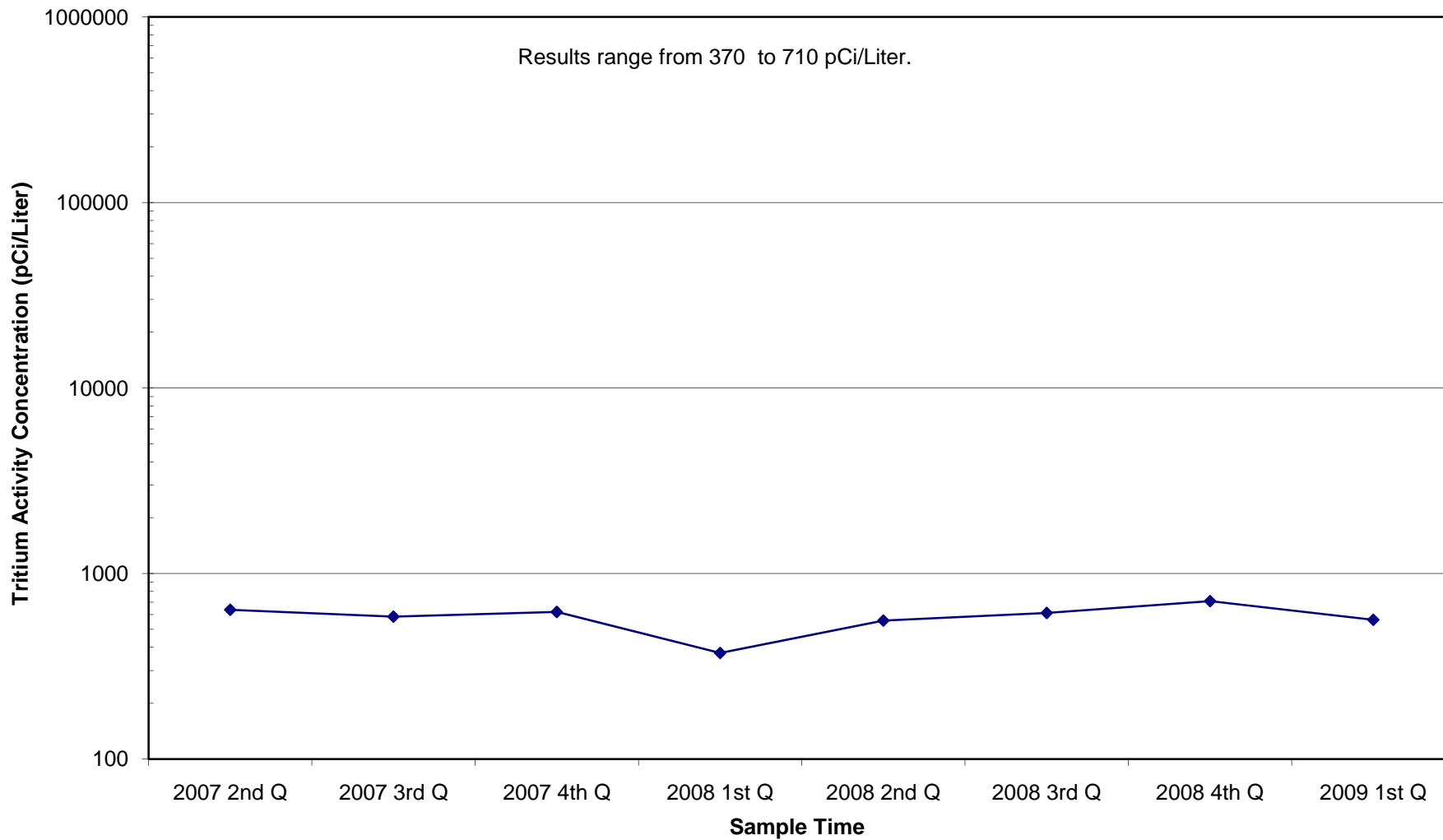
MAX Env Tech RW impoundment Landfill Leachate Tritium Activity Concentration Trend



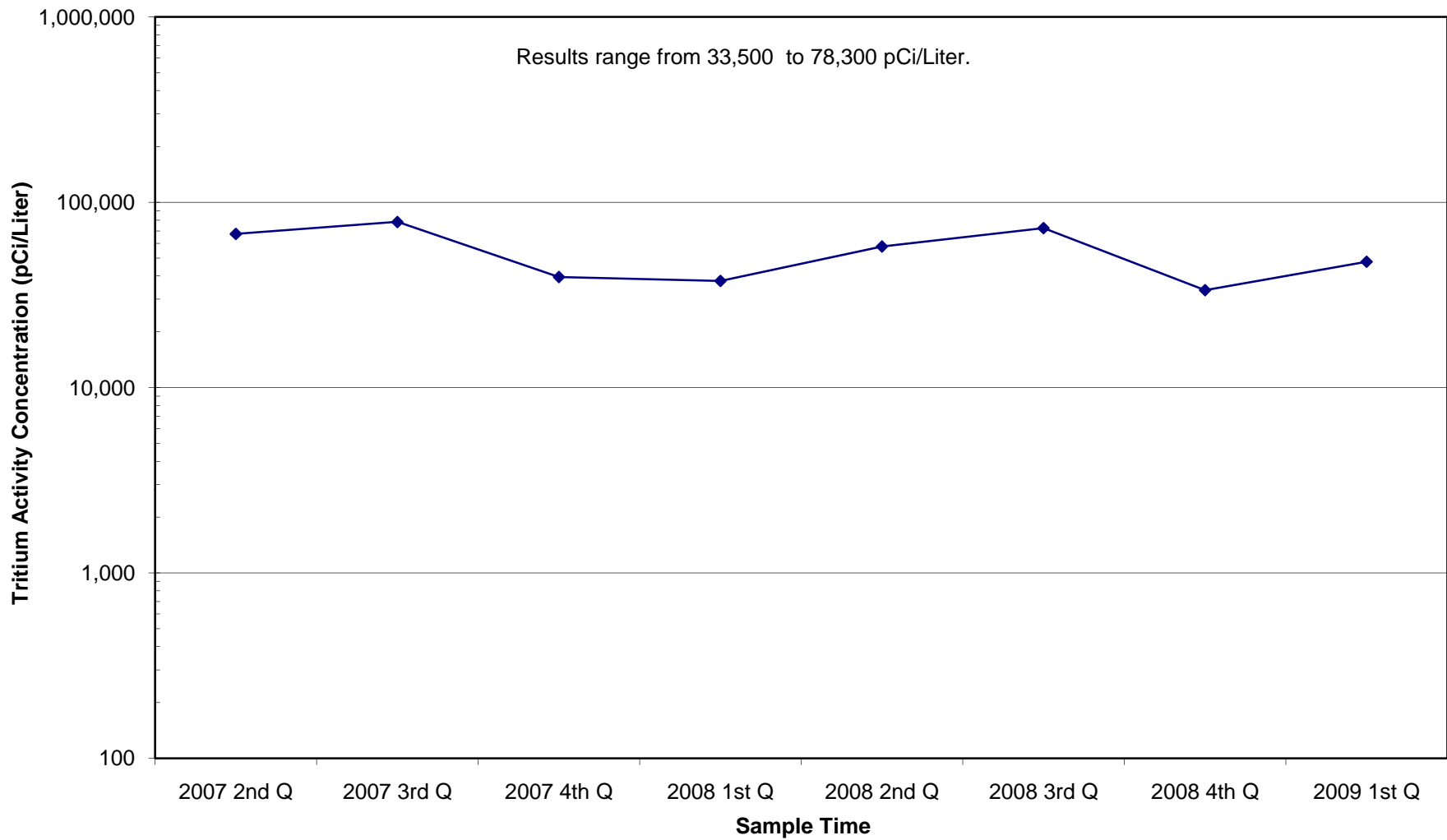
McKean Kness Landfill Leachate Tritium Activity Concentration Trend



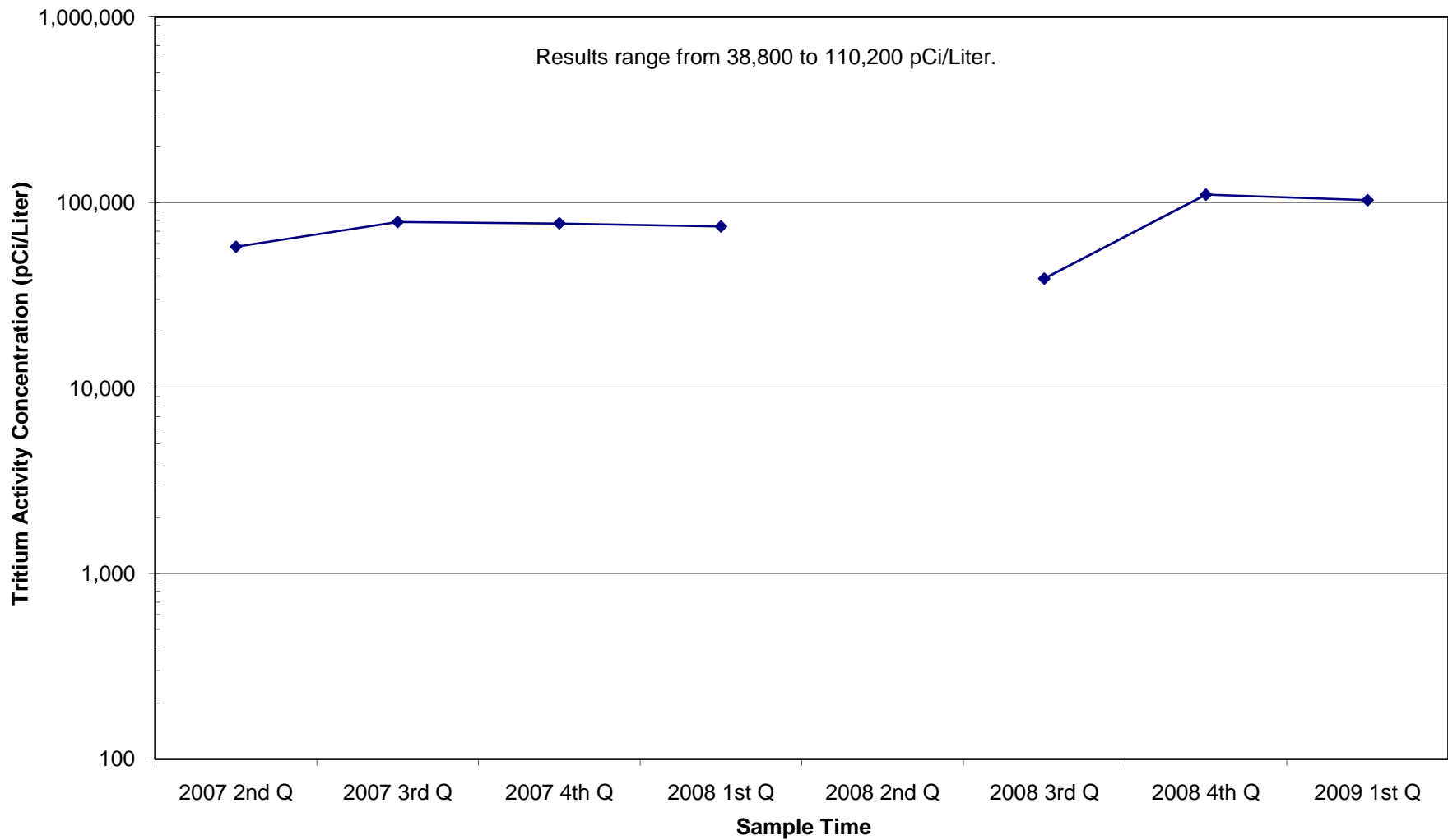
Mifflin County SWA Landfill Leachate Tritium Activity Concentration Trend



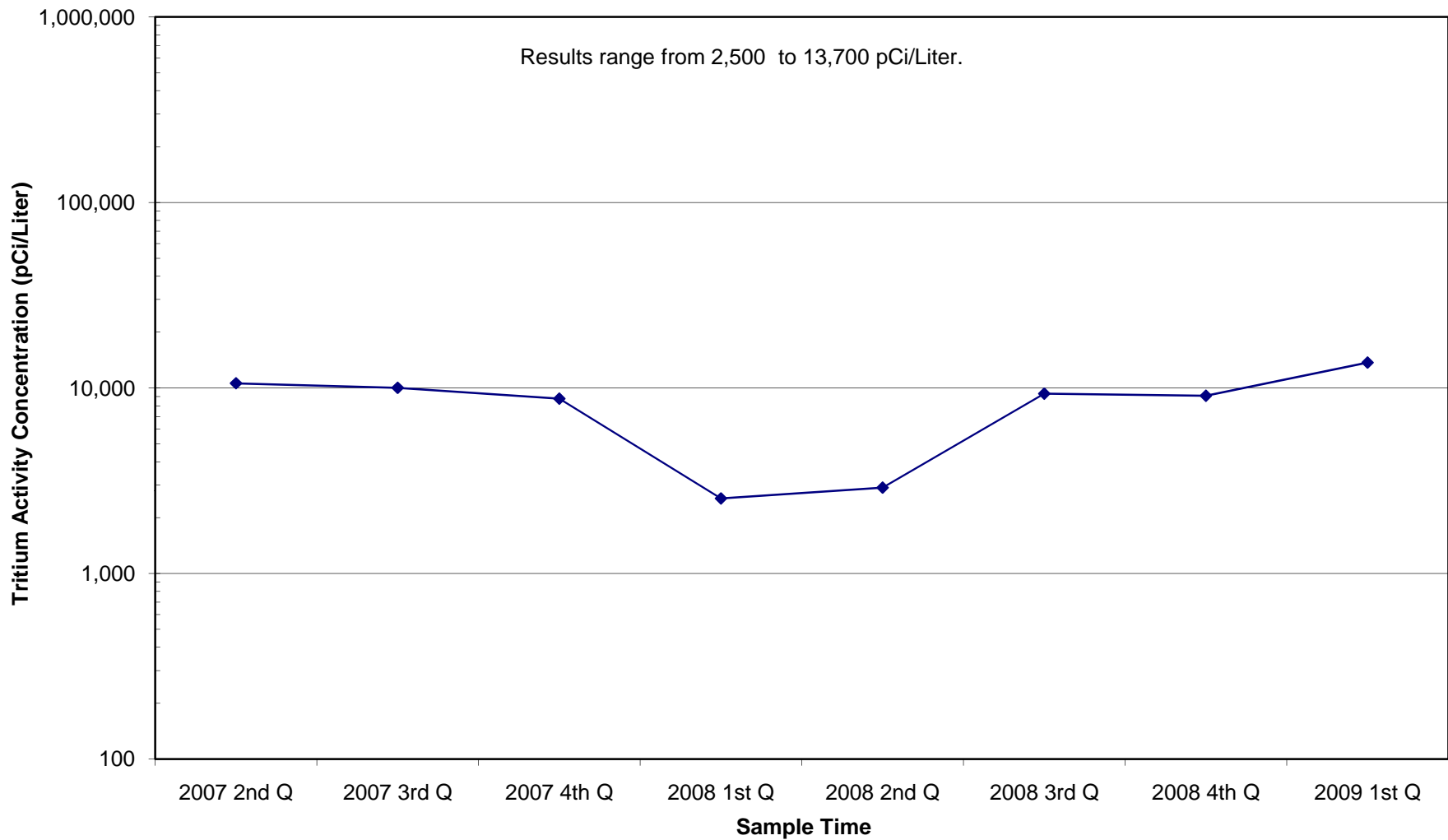
Milton Grove C & D Landfill Leachate Tritium Activity Concentration Trend



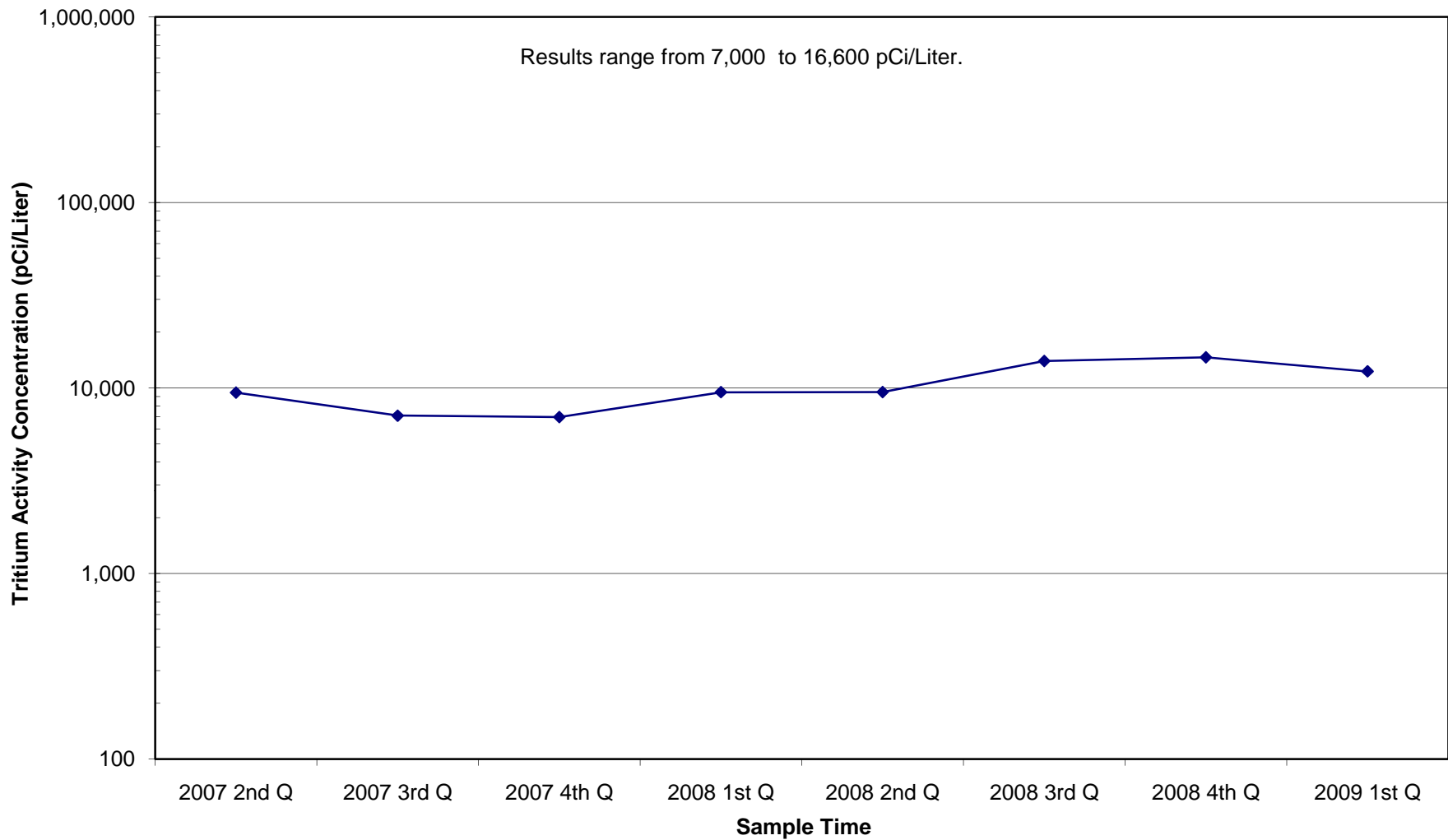
Modern Landfill Leachate Tritium Activity Concentration Trend



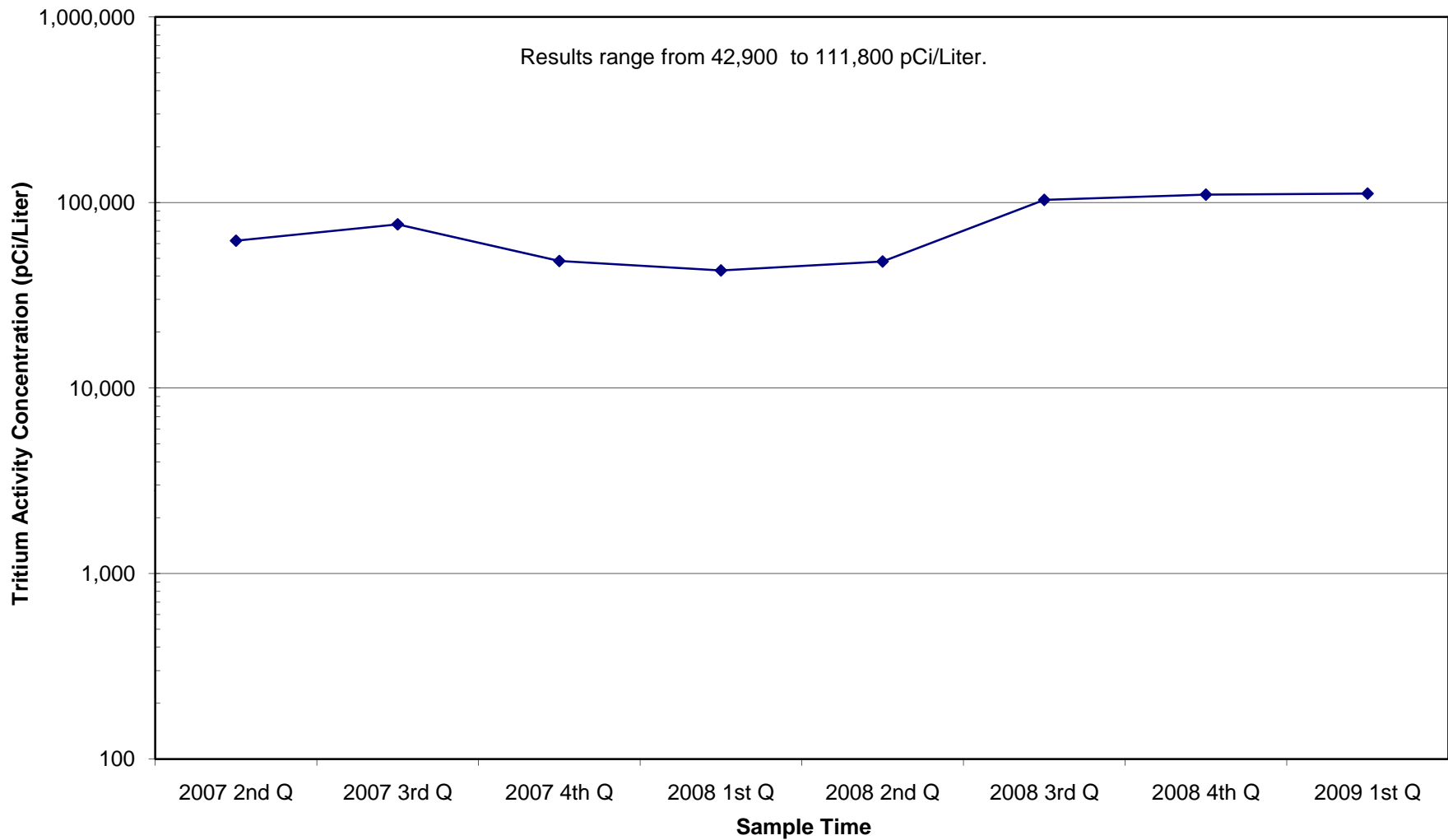
Monroeville Landfill Leachate Tritium Activity Concentration Trend



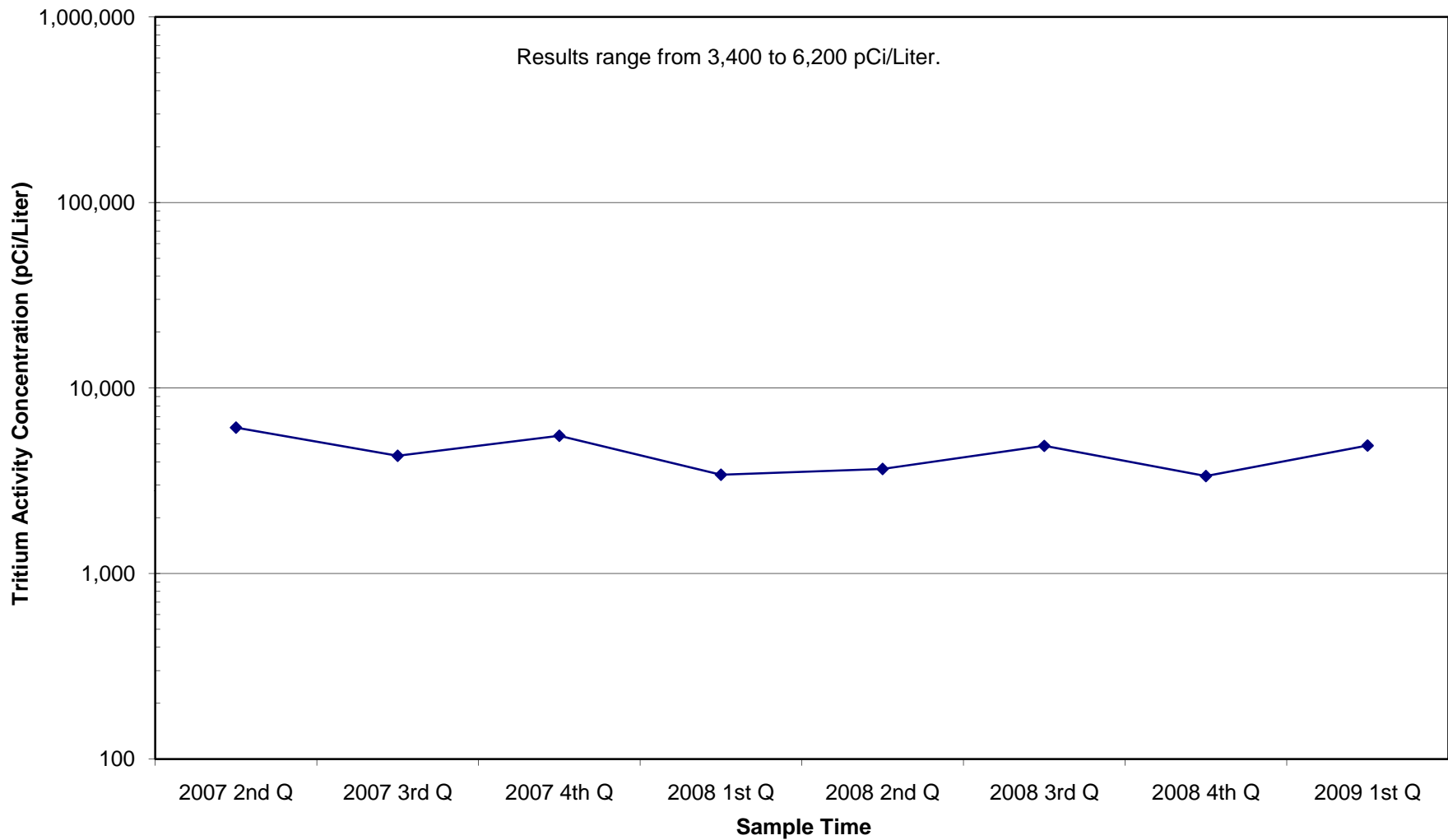
Mostoller Landfill Leachate Tritium Activity Concentration Trend



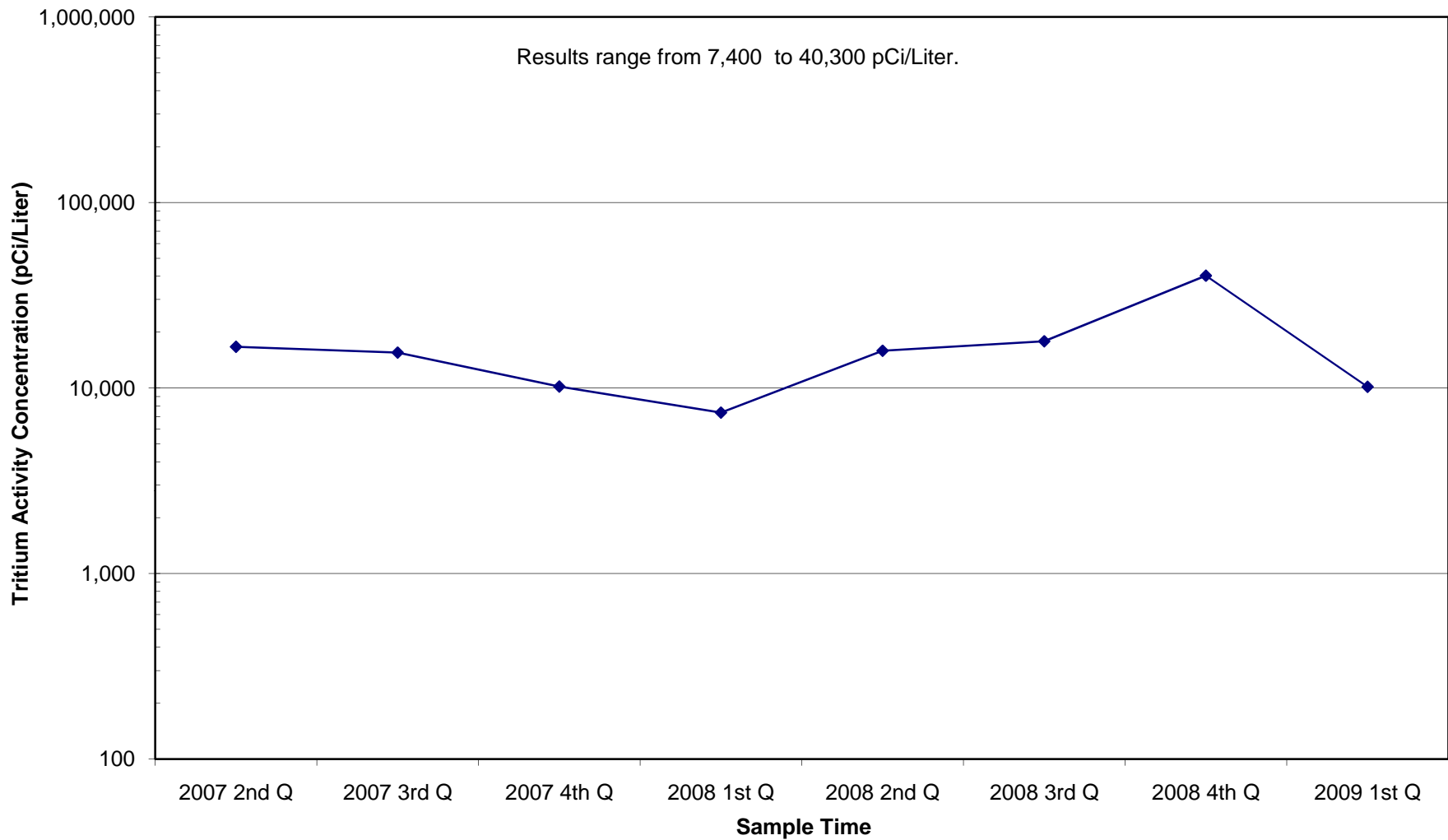
Mountain View Landfill Leachate Tritium Activity Concentration Trend



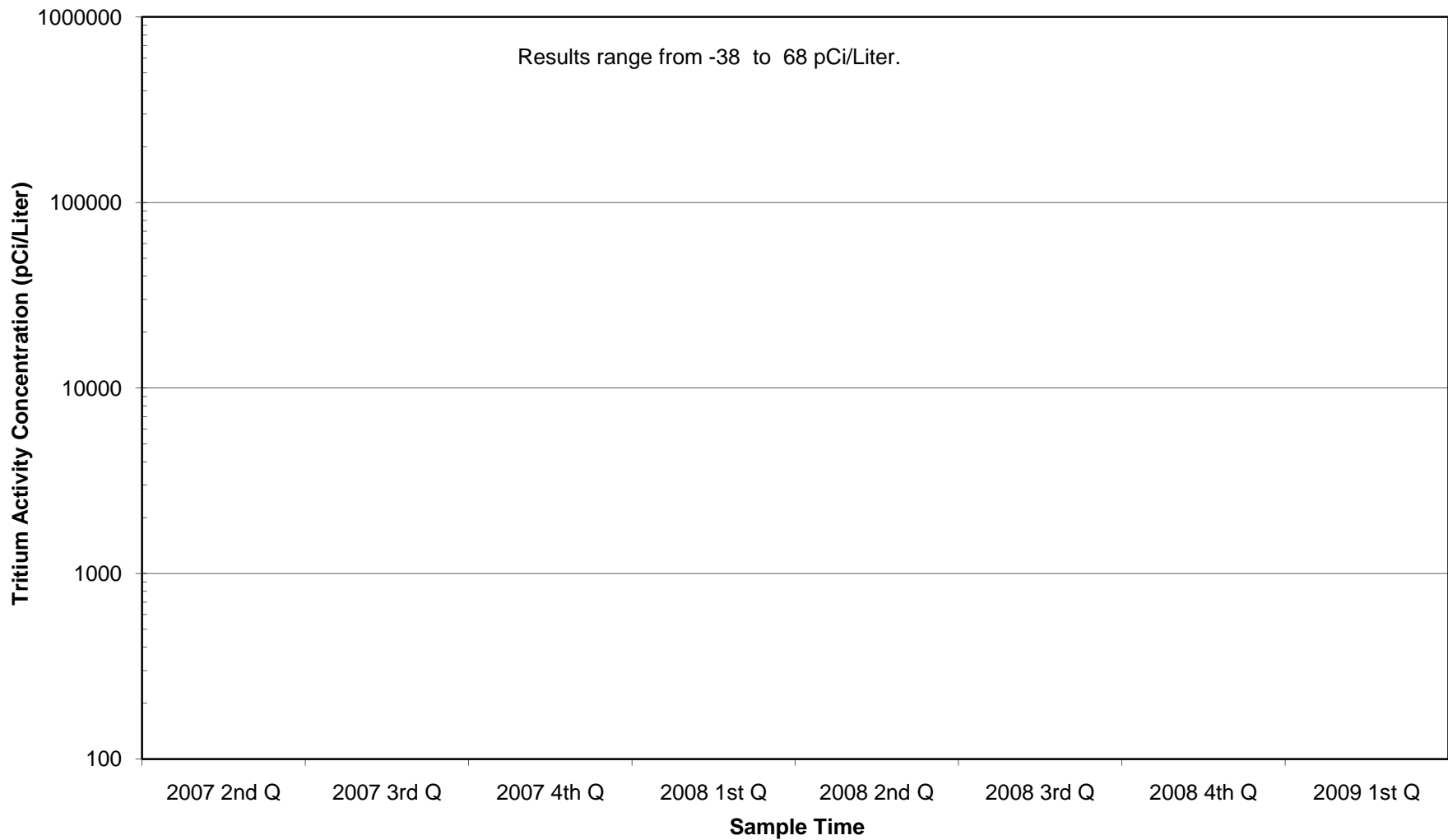
Northern Tier #2 Landfill Leachate Tritium Activity Concentration Trend



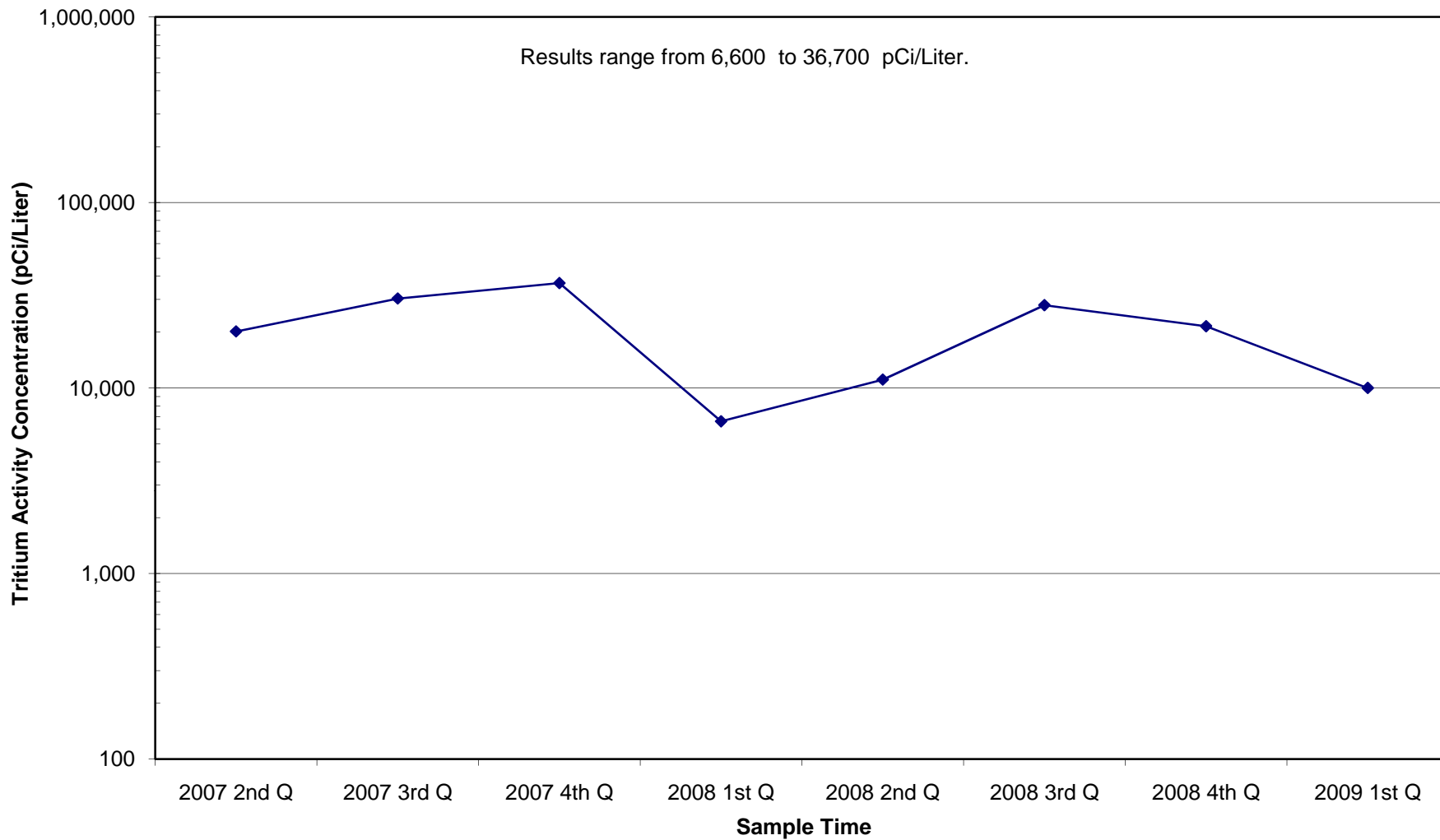
Northwest Sanitary Landfill Leachate Tritium Activity Concentration Trend



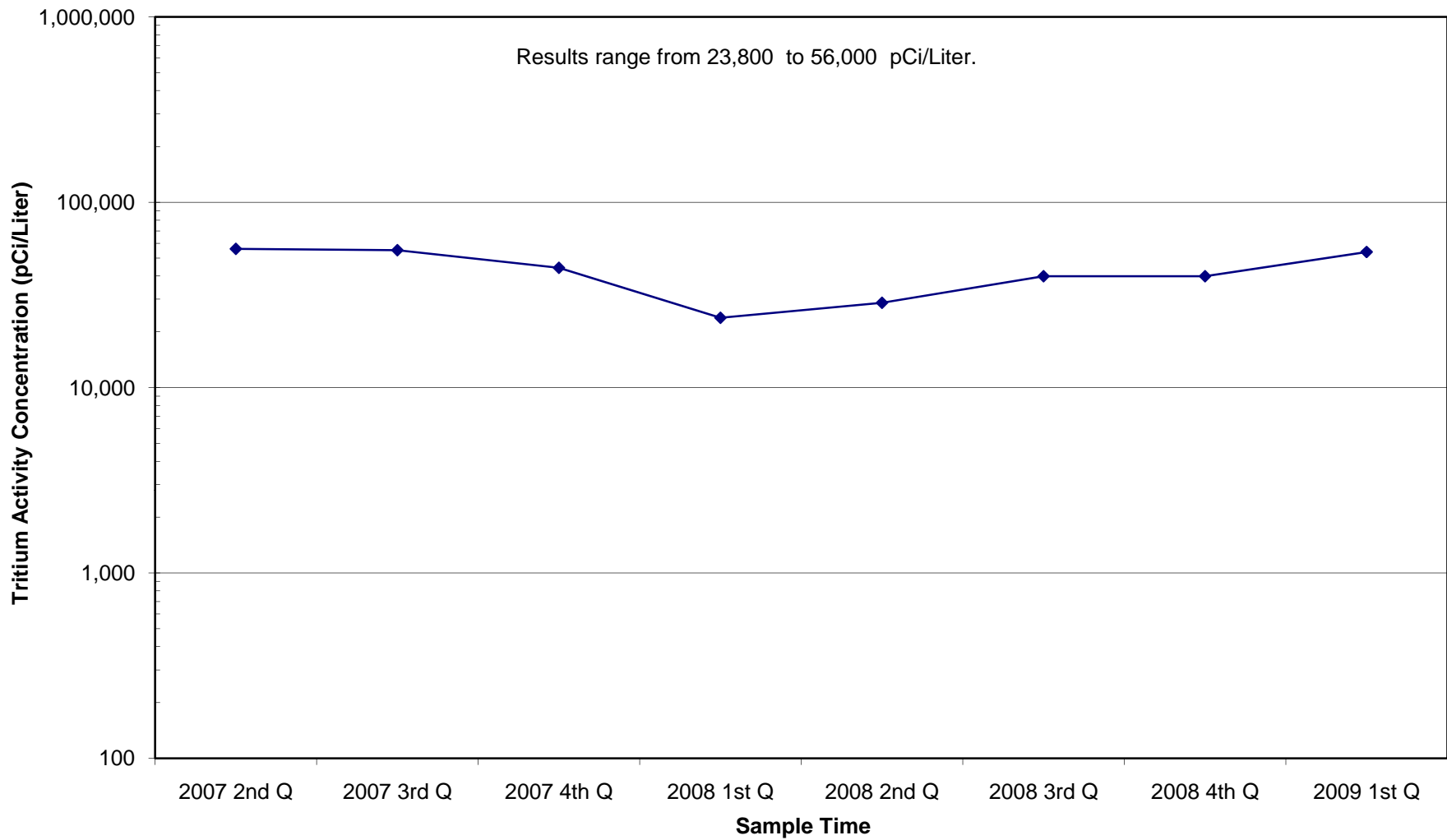
Paris Flyah Noncaptive Landfill Leachate Tritium Activity Concentration Trend



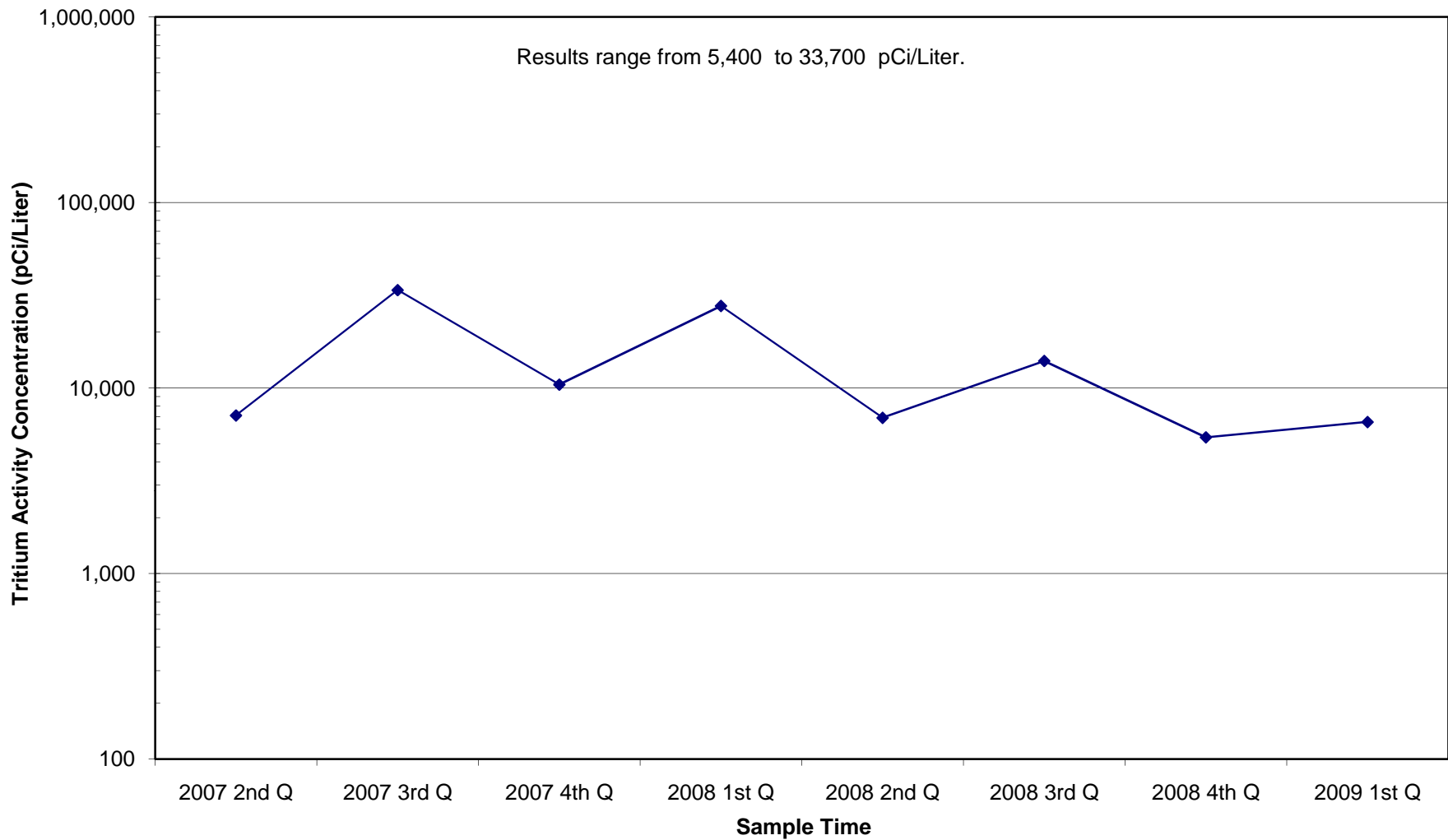
Pine Grove Landfill Leachate Tritium Activity Concentration Trend



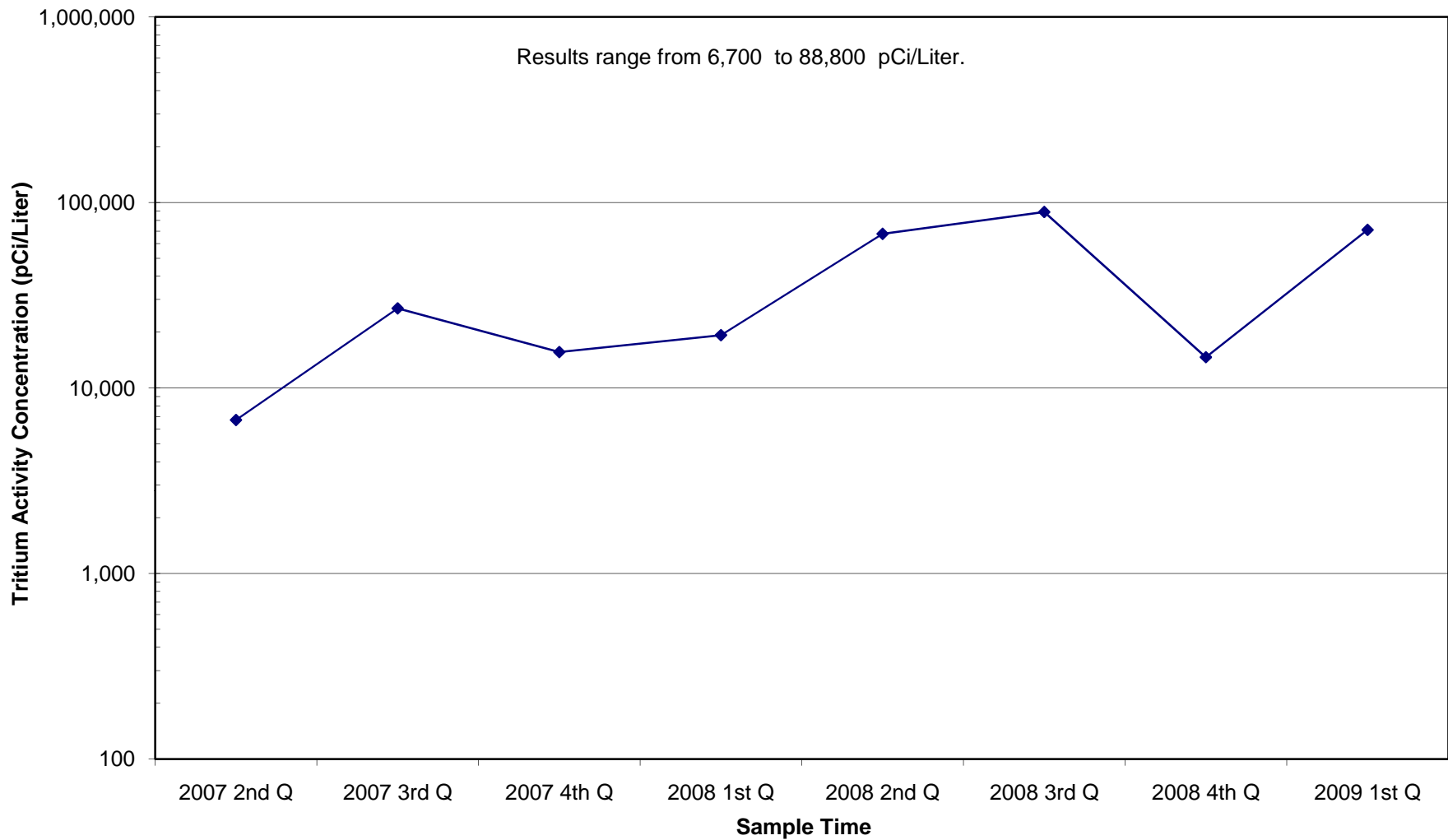
Pioneer Crossing Landfill Leachate Tritium Activity Concentration Trend



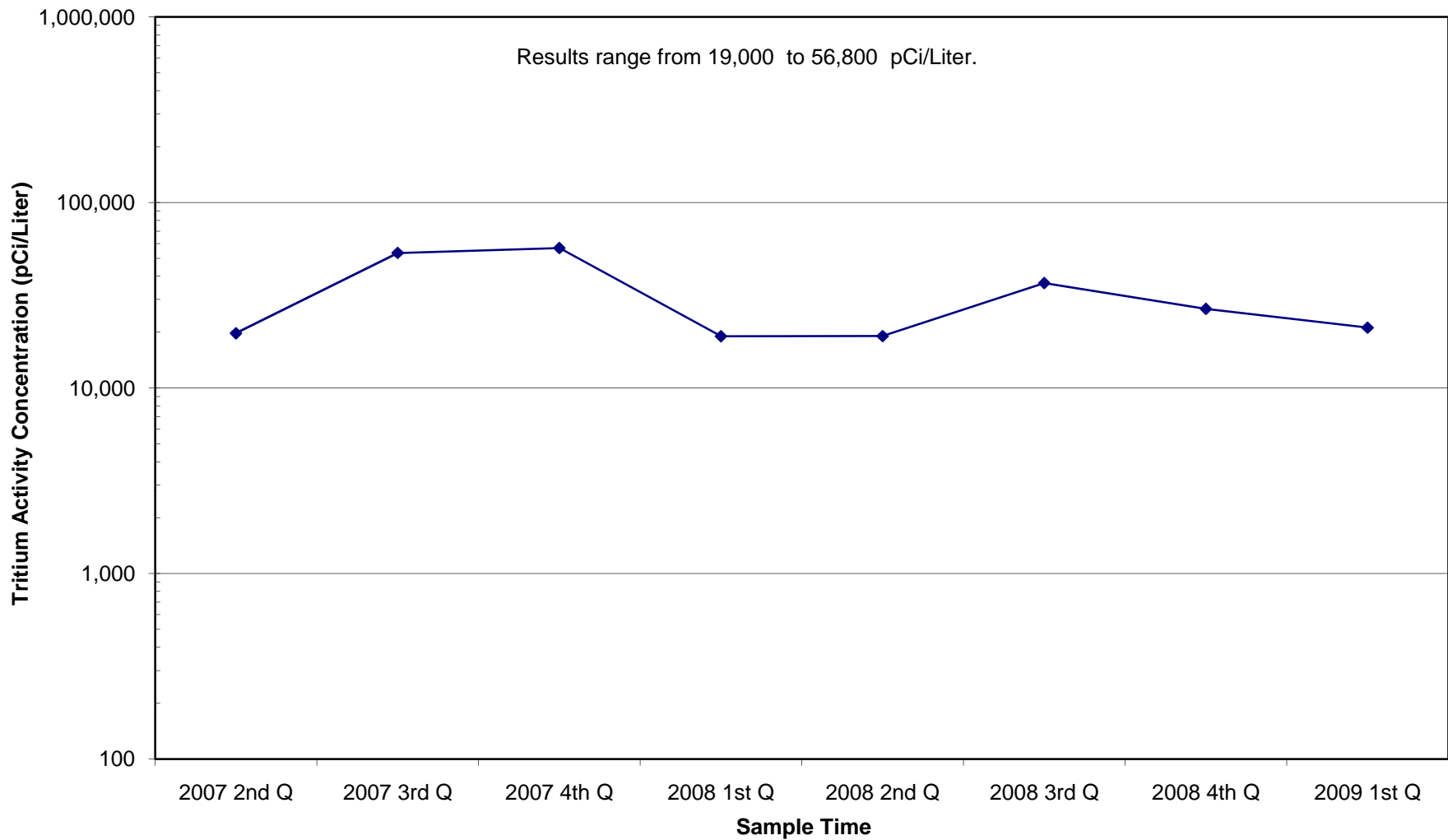
Pottstown Landfill Leachate Tritium Activity Concentration Trend



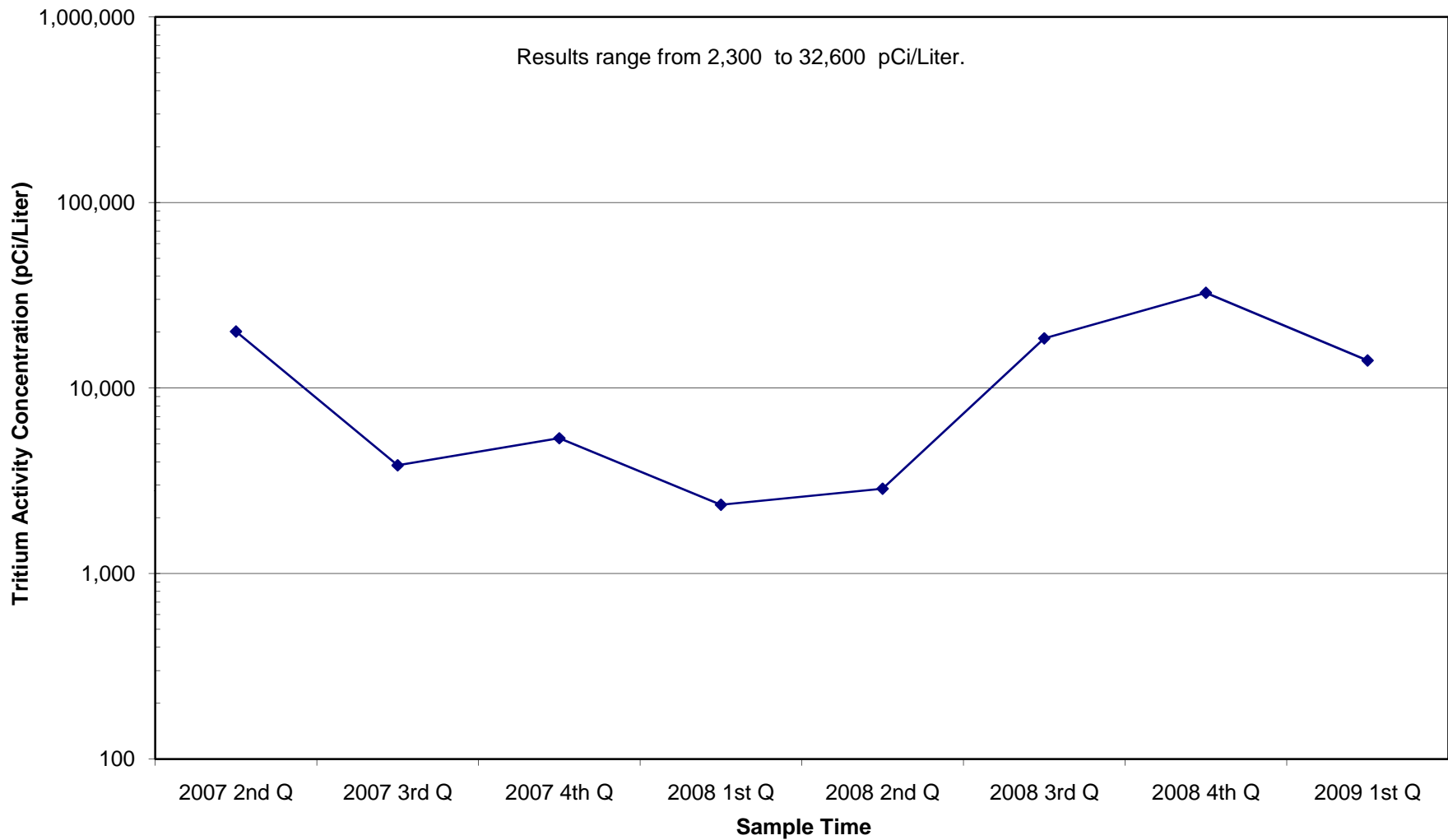
Sandy Run Landfill Leachate Tritium Activity Concentration Trend



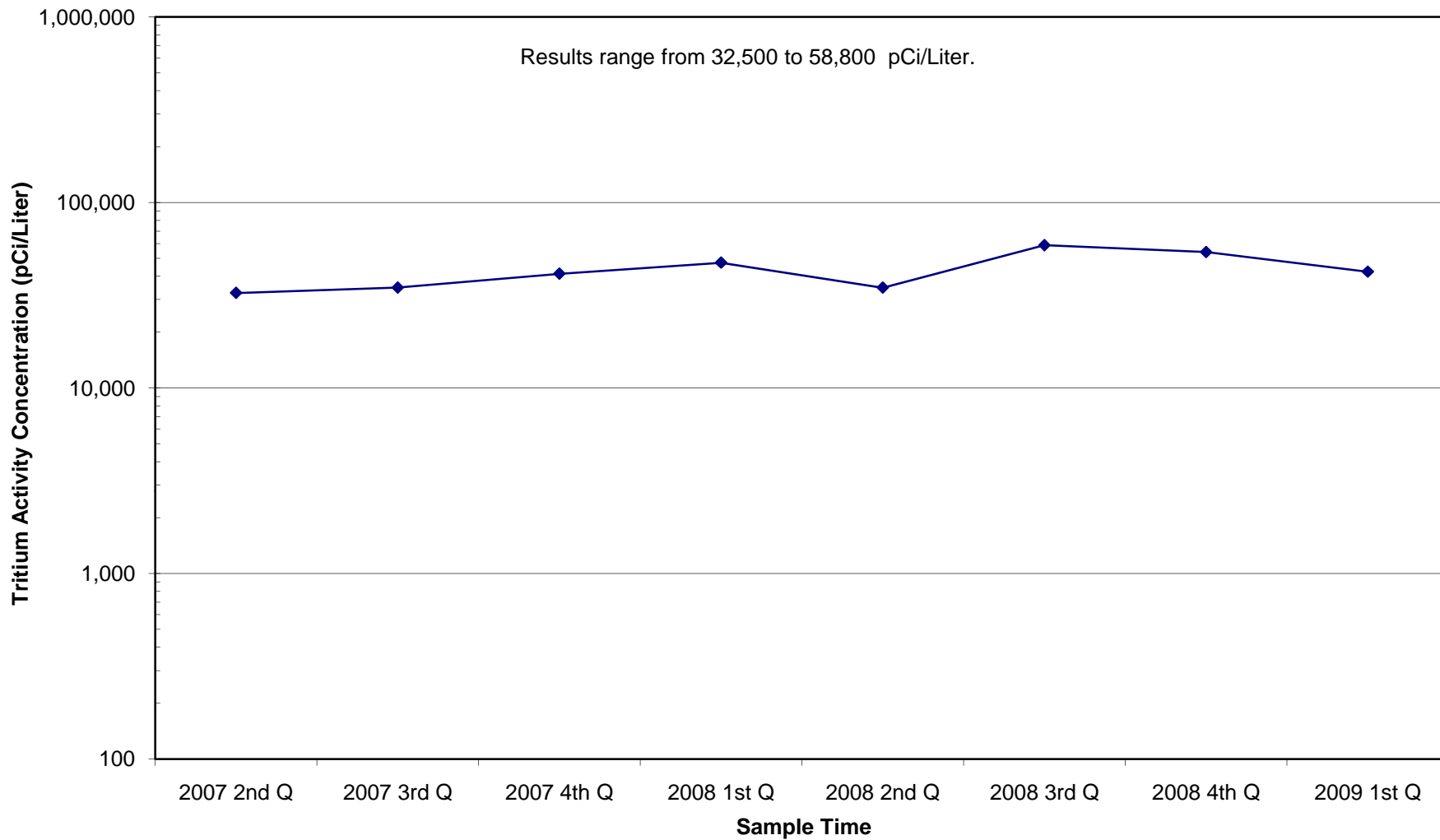
SECCRA Landfill Leachate Tritium Activity Concentration Trend



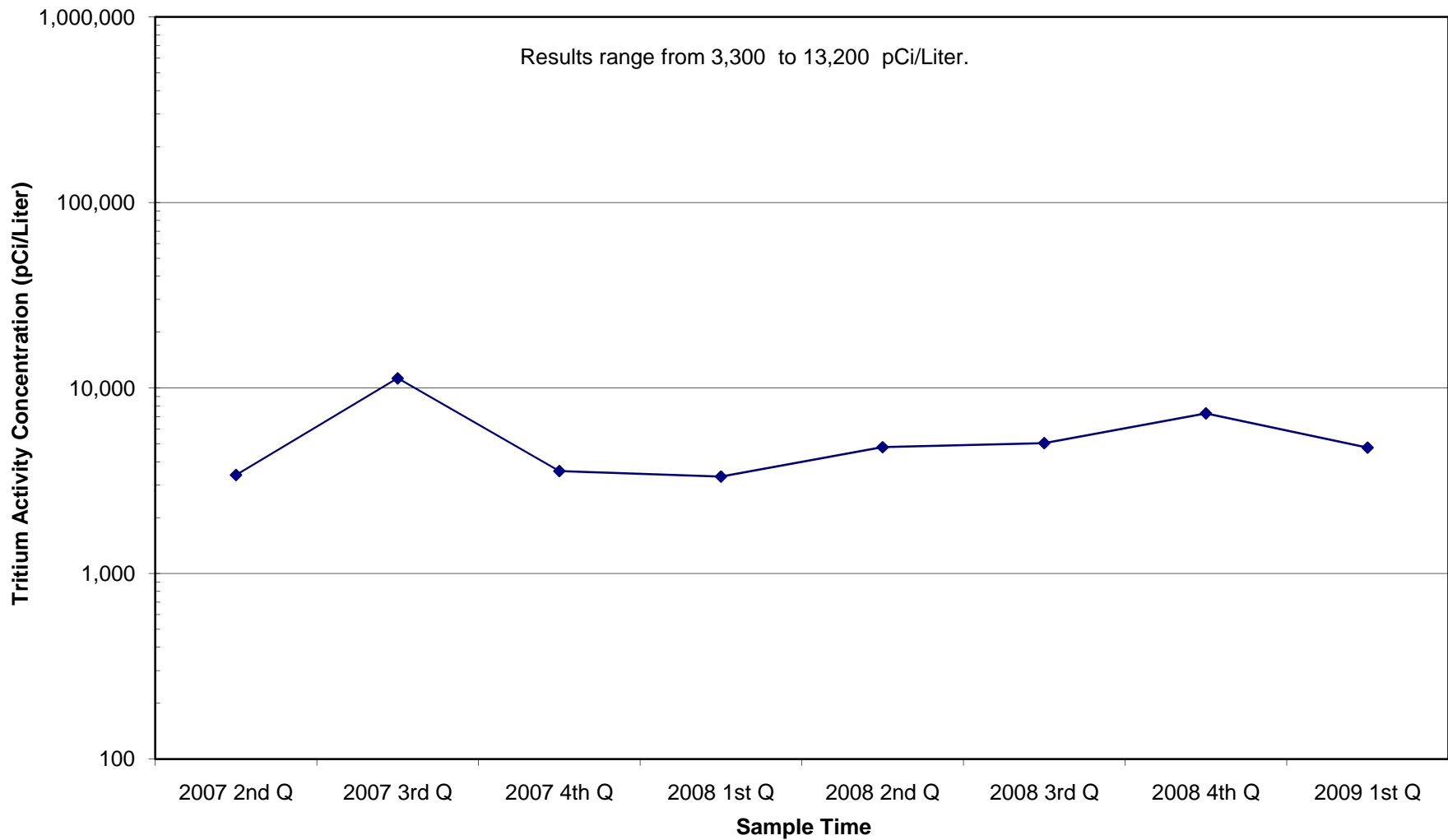
Seneca Landfill Leachate Tritium Activity Concentration Trend



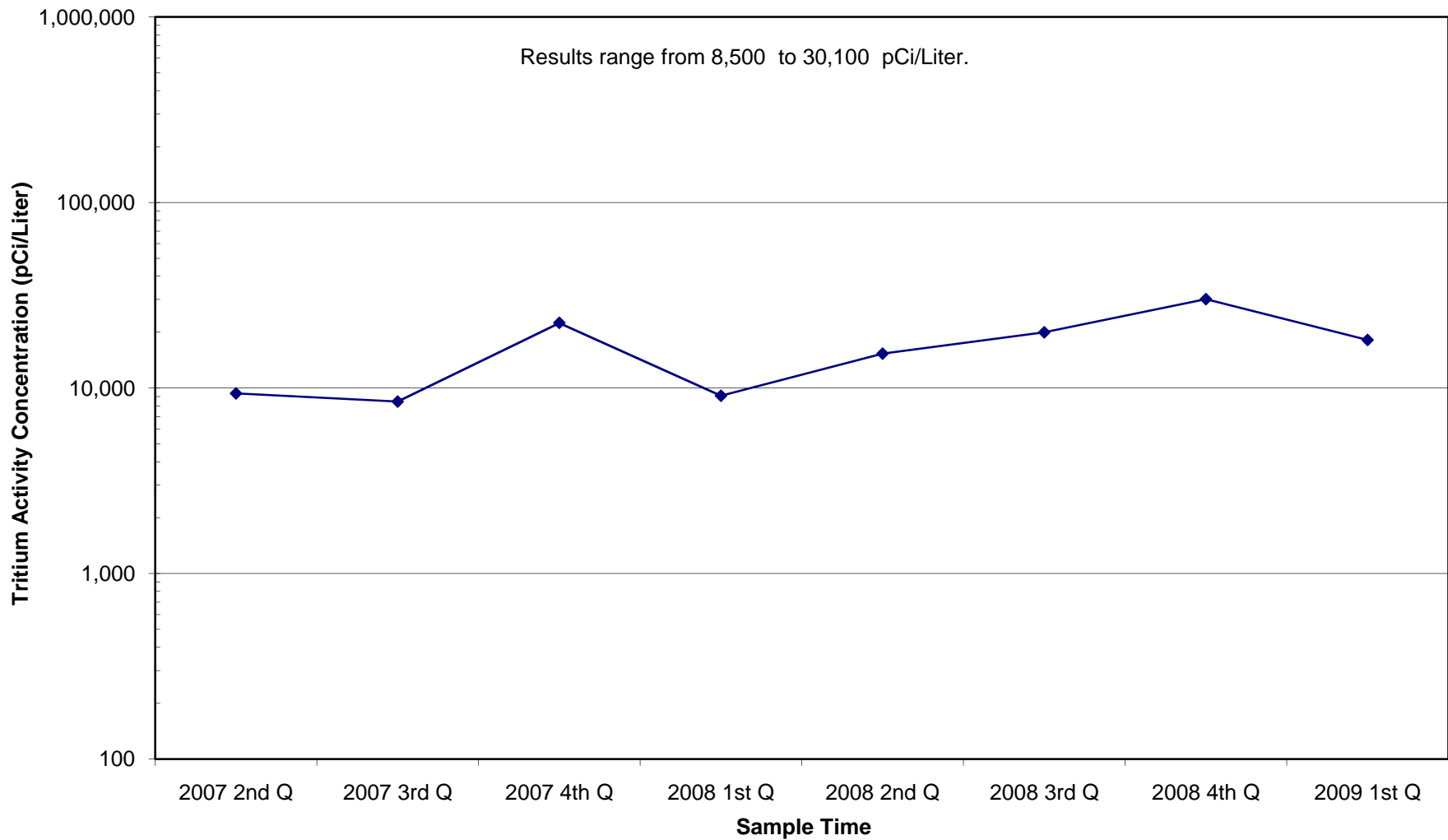
Shade Landfill Leachate Tritium Activity Concentration Trend



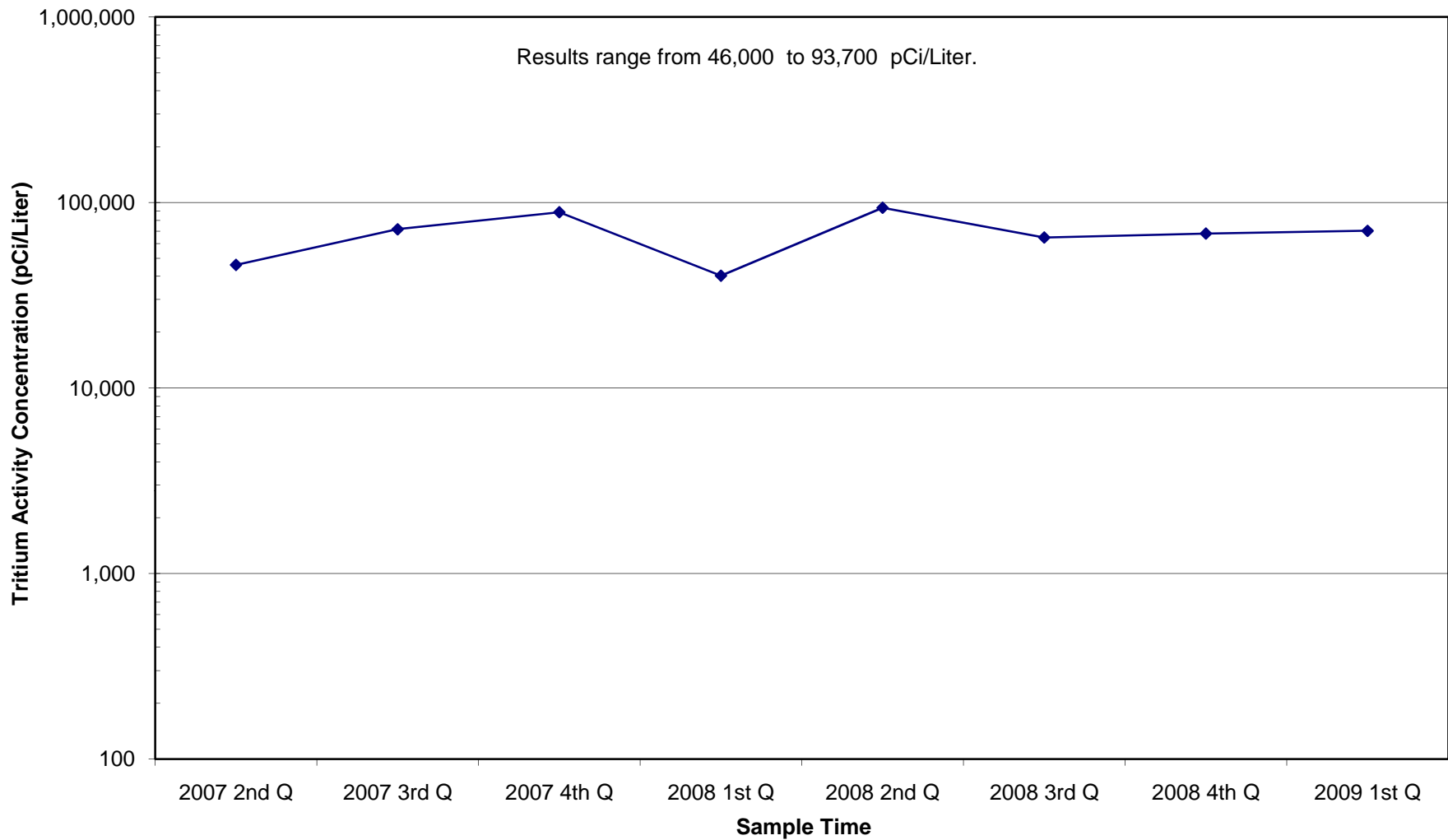
South Hills Landfill Leachate Tritium Activity Concentration Trend



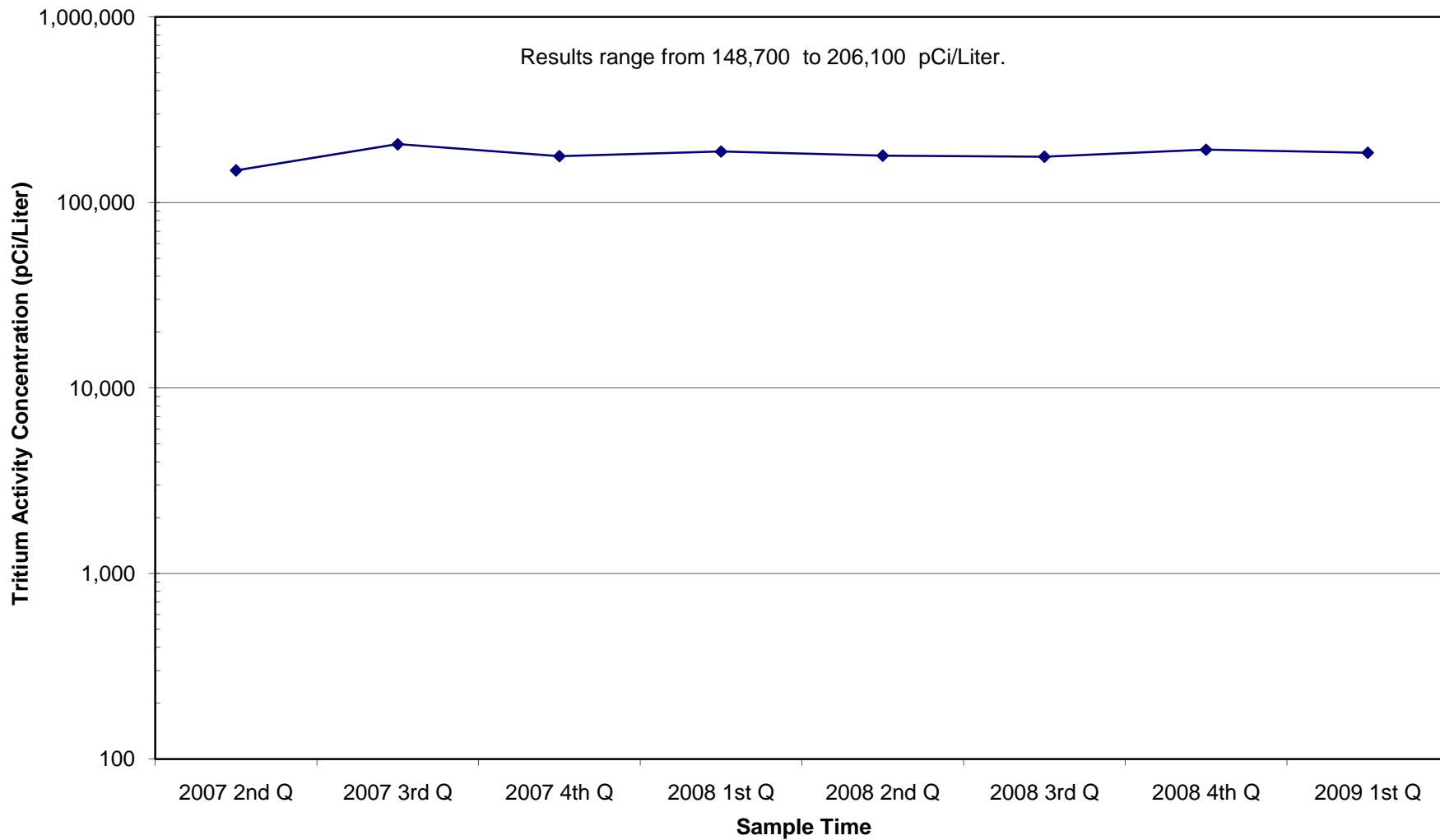
Southern Alleghenies Landfill Leachate Tritium Activity Concentration Trend



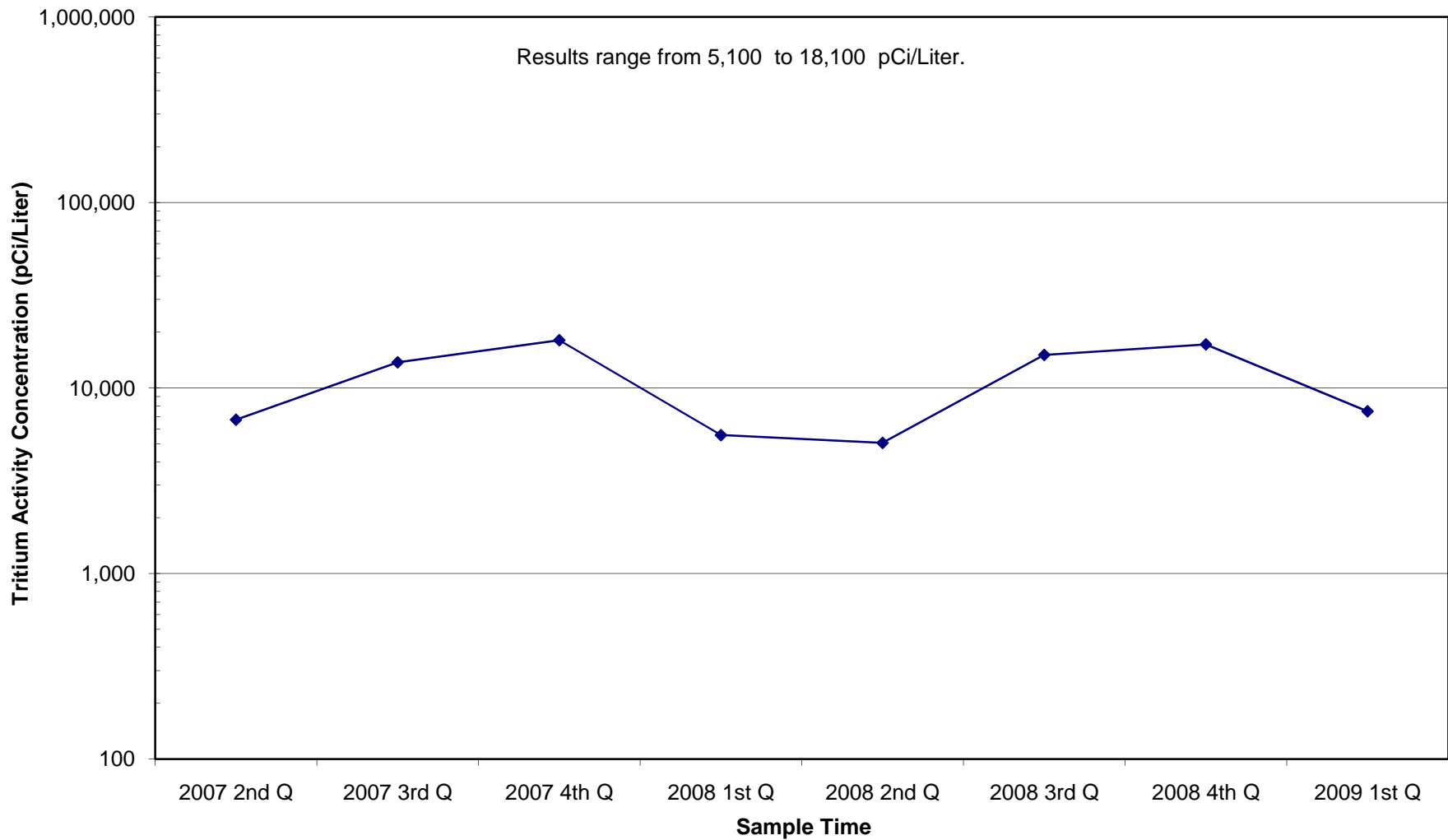
Superior Greentree Landfill Leachate Tritium Activity Concentration Trend



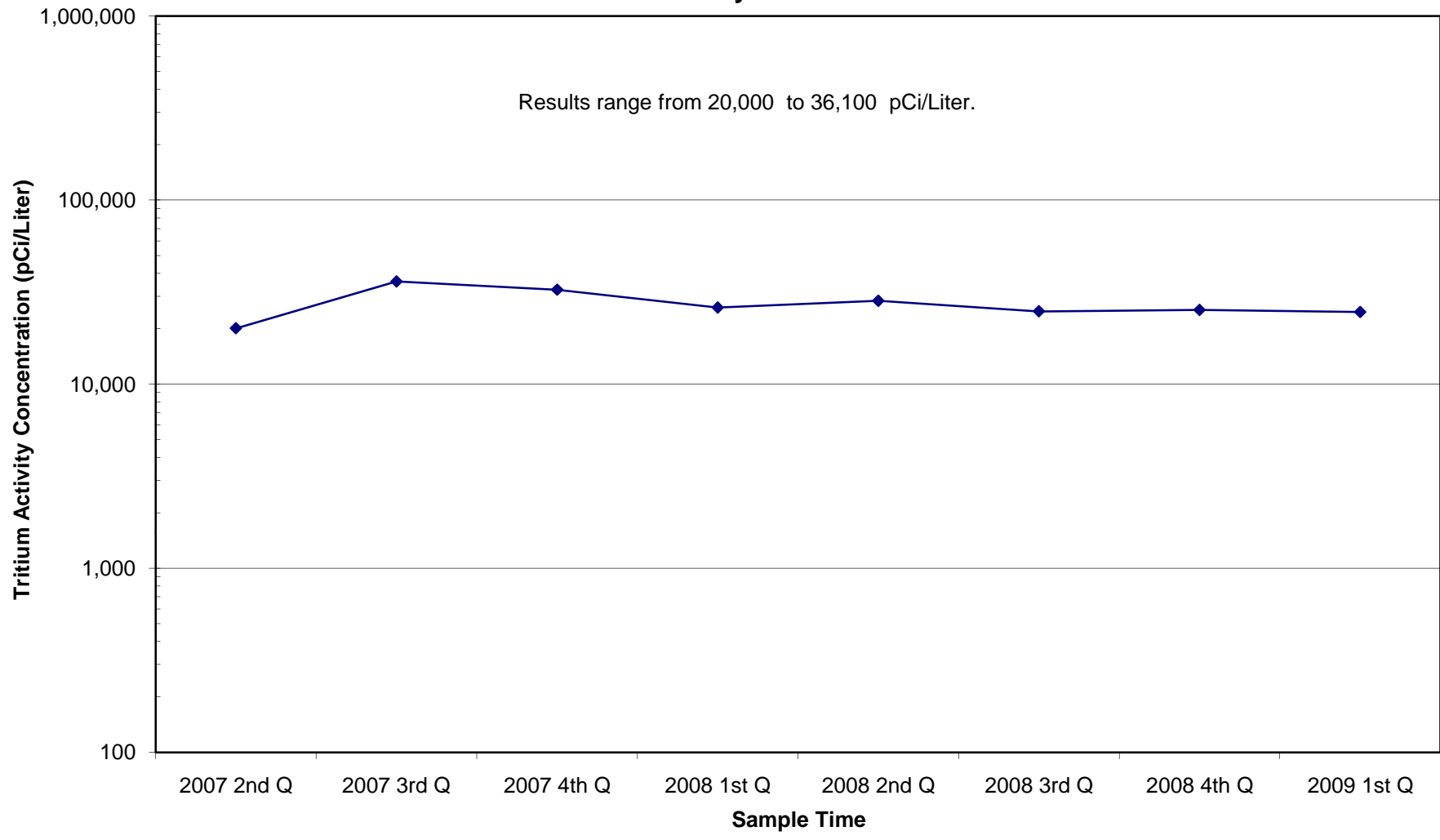
Tullytown RR Landfill Leachate Tritium Activity Concentration Trend



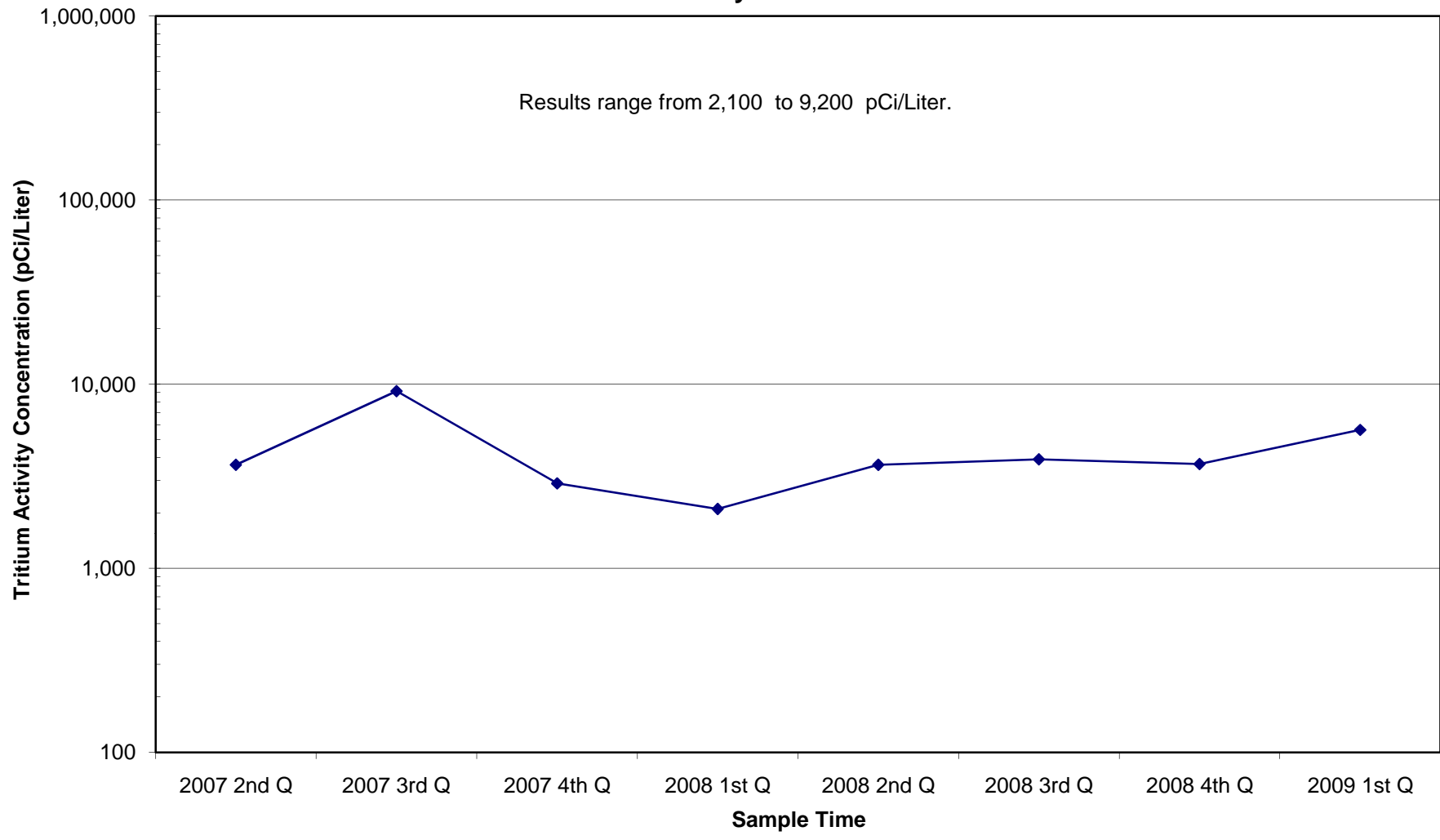
Valley Landfill Leachate Tritium Activity Concentration Trend



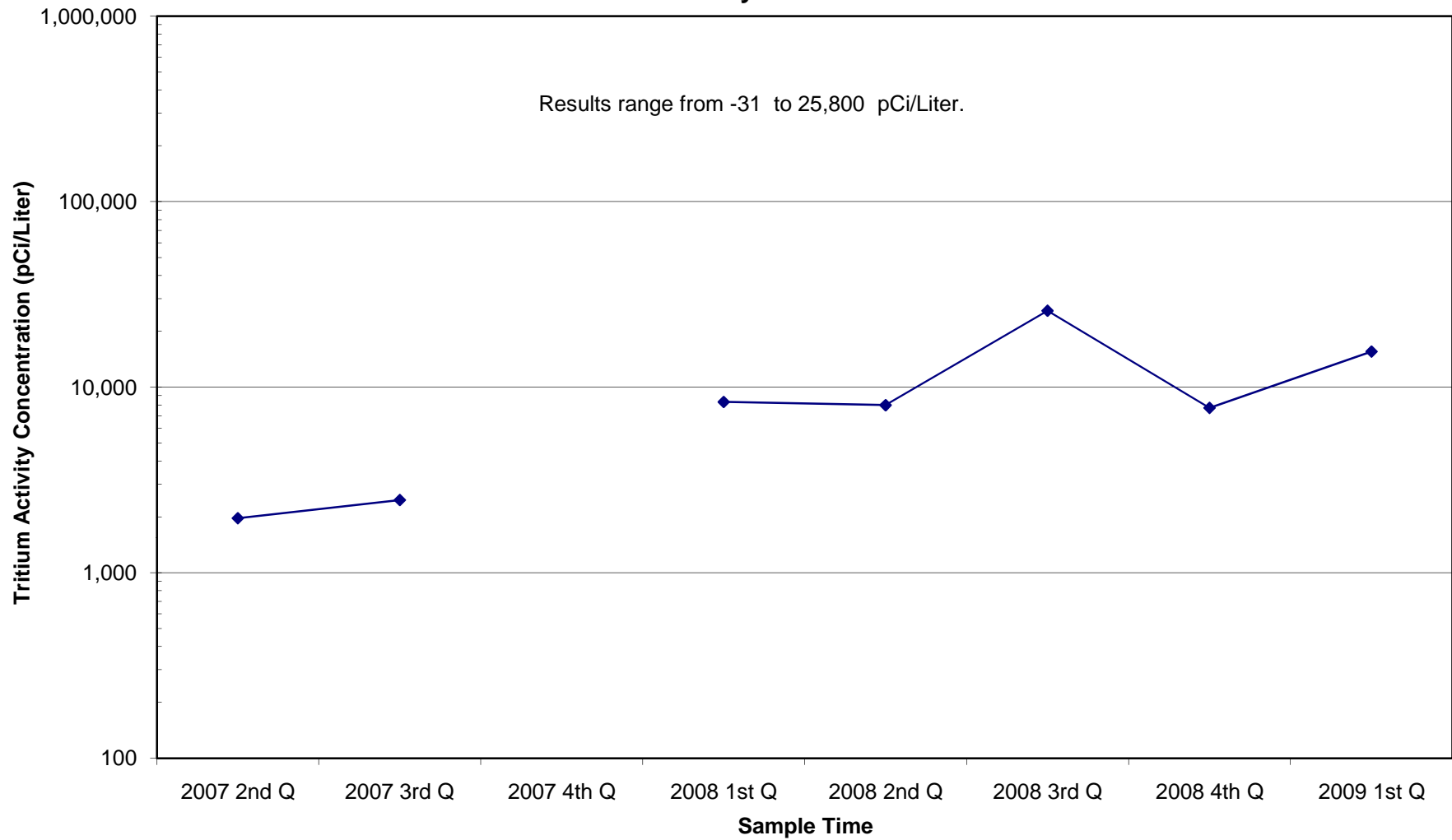
Wayne Township Landfill Leachate Tritium Activity Concentration Trend



Western Berks Comm Landfill Leachate Tritium Activity Concentration Trend



Westmoreland (Rostraver) Landfill Leachate Tritium Activity Concentration Trend



White Pines Landfill Leachate Tritium Activity Concentration Trend

