CONESTOGA-ROVERS & ASSOCIATES

5900 Hollis Street, Suite A
Emeryville, California 94608
Telephone: (510) 420-0700 Fax: (510) 420-9170
www.CRAworld.com

TRANSMITTAL

DATE: March 9, 2012

REFERENCE NO.: 060119

PROJECT NAME: 2350 (2368) Harrison Street, Oakland

TO: Jerry Wickham
Alameda County Environmental Health
1131 Harbor Bay Parkway, Suite 250
Alameda, California 94502-6577

RECEIVED
4:27 pm, Mar 13, 2012
Alameda County
Environmental Health

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- ☐ Prints
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QUANTITY	DESCRIPTION
1	Air Exchange Measurement Report

- ☐ As Requested
- ☐ For Your Use
- ☒ For Review and Comment
- ☐
- ☐

COMMENTS:
If you have any questions regarding the contents of this document, please call Peter Schaefer at (510) 420-3319.

Copy to: Denis Brown, Shell Oil Products US (electronic copy)
Richard Burge, 490 Grand Avenue, Suite 100, Oakland, CA 94610

Completed by: Peter Schaefer Signed: Peter Schaefer

Filing: Correspondence File

Denis L. Brown
Shell Oil Products US
HSE - Environmental Services
20945 S. Wilmington Ave.
Carson, CA 90810-1039
Tel (707) 865 0251
Fax (707) 865 2542
Email denis.l.brown@shell.com

Jerry Wickham
Alameda County Environmental Health
1131 Harbor Bay Parkway, Suite 250
Alameda, California 94502-6577

Re: Former Shell Service Station
2350 (2368) Harrison Street
Oakland, California
SAP Code 173318
Incident No. 97743969
ACEH No. RO0000505

Dear Mr. Wickham:

The attached document is provided for your review and comment. Upon information and belief, I declare, under penalty of perjury, that the information contained in the attached document is true and correct.

If you have any questions or concerns, please call me at (707) 865-0251.

Sincerely,

Denis L. Brown
Senior Program Manager

AIR CHANGE MEASUREMENT REPORT

FORMER SHELL SERVICE STATION
2350 (2368) HARRISON STREET
OAKLAND, CALIFORNIA

SAP CODE	173318
INCIDENT NO.	97743969
AGENCY NO.	RO0000505

Prepared by:
Conestoga-Rovers & Associates

5900 Hollis Street, Suite A
Emeryville, California
U.S.A. 94608

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web:http://www.CRAworld.com

MARCH 9, 2012
REF. NO. 060119 (22)
This report is printed on recycled paper.

TABLE OF CONTENTS

LIST OF FIGURES
(Following Text)

LIST OF APPENDICES

EXECUTIVE SUMMARY

- Utilizing ASTM methodology for air changes measurement, CRA conducted two air change measurements within the 7-Eleven convenience store at the subject site.
- The measurements demonstrated that the air change rate within the convenience store determined by regression analysis of data logged on the gas monitors was approximately 3.1 air changes/hour, ranging from 2.64 to 3.59 air changes/hour.
- During the initial air change testing, CRA staff noted relatively low air flow/air change rates of the two HVAC units servicing the building
- To evaluate if the two HVAC units were not performing as per their original design, CRA (through a subcontractor) performed maintenance on the two HVAC units.
- The HVAC maintenance contractor indicated that the units had an accumulation of dirt which restricted filters and evaporators within the HVAC units and significantly restricted air flow though the units.
- Following completion of the maintenance work, CRA re-measured the air changes within the building utilizing methodology prescribed by NEEB and ASHRAE. The re-measurement demonstrated significant improvement in air flow and corresponding air change in the building to approximately 11.5 air changes/hour.
- The measured air change rates of the two tests are higher than the default air change rate of 2 air changes/hour used in calculating RWQCB ESLs.
- The calculated minimum air change rate needed to dismiss benzene SVI into the building is 2.3 air changes/hour, so the minimum air change measurement of 2.64 air changes/hour demonstrates that there is no benzene SVI concern. With the maintenance performed on the HVAC units and the significant increase in air changes per hour within the building, the potential for SVI is even a lesser concern.
- Due to the noted number of air exchanges occurring within the existing 7-Eleven convenience store, and based on the highest benzene and TPHg detections in near sub-slab soil vapor probes located directly adjacent to the store, there does not appear to be a human health-based risk of potential SVI into the convenience store which would exceed screening levels for commercial building indoor air quality.
- The site is likely to remain a convenience store with a paved parking lot for the foreseeable future. Thus, there are no existing or potential receptors that are currently or could be reasonably anticipated to be impacted by the residual hydrocarbon impacts to the shallow soils and groundwater underlying the site.
- Therefore, on behalf of Shell, CRA respectfully recommends closure of this case. CRA requests that ACEH suspend the groundwater monitoring program during the closure review.

1.0 INTRODUCTION

Conestoga-Rovers & Associates (CRA) prepared this report on behalf of Equilon Enterprises LLC dba Shell Oil Products US (Shell) to document the air change rate measurements taken within the on-site 7-Eleven store building. CRA followed the scope of work and procedures presented in CRA's October 8, 2011 *Air Exchange Measurement Work Plan* which was approved by the Alameda County Environmental Health's (ACEH's) November 17, 2011 letter and as discussed in a telephone conversation between CRA and ACEH on December 15, 2011.

During the initial air change measurement work, CRA noted relatively low air flow rates from the vents of the store's two heating, ventilation, and air conditioning (HVAC) units. Following completion of the initial air change measurement work, CRA performed standard maintenance of the two units, and then conducted a second air change measurement, which indicated a significant increase in air changes per hour within the building following completion of the HVAC maintenance work. This report documents the air change measurement work performed.

The subject property is a former Shell service station located on the southern corner of the Harrison Street and Bay Place intersection in Oakland, California (Figure 1). The layout of the former station (whose address was 2368 Harrison Street) included underground fuel storage tanks (USTs), a waste oil UST, three dispenser islands, and a station building (Figure 2). All USTs and fuel distribution and dispensing facilities have been removed. The site is currently occupied by a 7-Eleven Store (whose address is 2350 Harrison Street), and the area surrounding the station is a mix of commercial and residential use.

A summary of previous work performed at the site and additional background information was presented in CRA's October 8, 2011 *Air Exchange Measurement Work Plan* and is not repeated herein.

2.0 INITIAL AIR CHANGE MEASUREMENT

2.1 FIELD DATE

December 19, 2011.

2.2 PERSONNEL PRESENT

Staff engineer Emerson Baldoz directed the air change measurements under the supervision of California licensed civil engineer Lee Brennan.

2.3 AIR CHANGE TEST PROCEDURE

CRA performed two air change rate tests inside the on-site 7-Eleven building in general conformance with the American Society for Testing and Materials International (ASTM) Standard E741 - *Standard Test Method for Determining Air Change in a Single Zone by Means of a Tracer Gas Dilution.* As discussed in a telephone conversation with ACEH on December 15, 2011, CRA used carbon dioxide as a tracer gas rather than helium which was proposed in our October 8, 2011 work plan.

The two tests were performed by releasing commercial-grade carbon dioxide into the store at high velocity to ensure good mixing until the carbon dioxide concentration reached approximately 5,000 parts per million. The carbon dioxide concentration was measured and recorded at one-second intervals using three sensors positioned inside the 7-Eleven building before, during, and after the release of the carbon dioxide gas. The air change rate was calculated using a first-order exponential equation for the carbon dioxide decay rate.

The two air change measurements were made between 9:35 and 10:05 AM (low foot traffic volume) and between 12:10 and 12:35 PM (high foot traffic volume). The approximate volume of the retail portion of the 7-Eleven store is 11,400 cubic feet.

2.4 FINDINGS

The determined pre-HVAC maintenance air change rates are summarized in the following table.

Description	*Approximate air changes per hour calculated by regression analysis from logged data*
Average during low foot traffic (mid morning)	2.75
Average during high foot traffic (lunch hour)	3.26
Minimum	2.64
Maximum	3.34
Overall average	3.11

The estimated potential error in these measurements is plus or minus 0.3 air changes per hour. Details of the air change measurements are presented in Appendix A.

3.0 HVAC SYSTEM MAINTENANCE

The air change rate determined by the initial testing was judged to be relatively low for a commercial retail establishment, based on current building codes. As such, CRA contracted with B.A. Morrison (Morrison) to have routine maintenance work performed on the two HVAC units servicing the building. The maintenance work performed indicated that the HVAC units had a significant accumulation of dirt which filled evaporators and clogged air filters, greatly restricting air flow through the units. A copy of Morrison's findings and recommendations is provided in Appendix B. The completion of the HVAC maintenance work resulted in a significant improvement in air flow and corresponding air change in the building. Following completion of the maintenance work, CRA then performed a remeasurment of air changes within the building utilizing a more direct methodology, as prescribed by National Environmental Balancing Bureau (NEBB) and American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASRAE).

4.0 POST- HVAC MAINTENANCE AIR CHANGE MEASUREMENT

4.1 FIELD DATE

February 29, 2012.

4.2 PERSONNEL PRESENT

Staff engineer Emerson Baldoz directed the air change measurements under the supervision of California licensed civil engineer Lee Brennan.

4.3 AIR CHANGE TEST PROCEDURE

Following completion of HVAC maintenance work, CRA performed a second measurement of air changes within the 7-Eleven building in conformance with NEBB and ASRAE procedural standards (NEEB 6.5.3 & ASHRAE 62-2001). This air change measurement methodology is considered to be a more direct measurement of air changes occurring within a building than the ASTM methodology previously utilized, and is used for environmental air balancing within buildings to meet Leadership in Energy and Environmental Design and other building standards. Carter Air Balance Company (Carter) was retained to perform the air exchange measurement. Carter utilized an Alnor flow hood to obtain direct supply and return air total flow rates of both units.

4.4 FINDINGS

The determined post-HVAC maintenance air change rate for the 7-Eleven convenience store building was 11.49 air changes per hour. A copy of Carter's testing results is provided in Appendix C.

5.0 CONCLUSIONS

The calculated air change rate is higher than the default air change rate of 2 air changes per hour used in calculating San Francisco Bay Regional Water Quality Control Board (RWQCB) environmental screening levels[1] (ESLs). Concentrations of benzene and total petroleum hydrocarbons as gasoline (TPHg) previously detected in near sub-slab soil vapor probes SVP-4 and SVP-5 indicate a potential risk for soil vapor intrusion (SVI). It should be noted that RWQCB ESL guidance advises that "TPH ESLs must be used in conjunction with ESLs for related chemicals (e.g. BTEX, polynuclear aromatic hydrocarbons, oxidizers, etc.)." In this case, volatile organic compounds would

1 *Screening for Environmental Concerns at Site With Contaminated Soil and Groundwater,* California Regional Water Quality Control Board, Interim Final – November 2007 [Revised May 2008]

be the appropriate related chemicals, and only benzene was detected at a concentration above ESLs. The calculation of the minimum air change rate needed to dismiss the SVI for benzene is presented below.

5.1 BENZENE SVI ANALYSIS

CRA calculates the minimum air change rate to dismiss the potential for benzene in soil vapor to cause an exceedence of the commercial indoor air ESL using the commercial indoor air ESL in the following calculation.

(1) The soil gas to indoor air attenuation factor (AF) is defined as:

$$AF = C_{indoor} / C_{soil\ gas}$$

Where:
C_{indoor} = commercial indoor air screening level[2]; and
$C_{soil\ gas}$ = highest soil gas concentration[3].

For our case, the AF we need to achieve is

$$AF = 0.42\ \mu g/m^3 / 950\ \mu g/m^3 = 0.00044.$$

(2) RWQCB's November 2008 ESL document calculates AF as:

AF = vapor intrusion rate/(vapor intrusion rate + indoor air flow rate)

The default vapor intrusion rate given in the previously referenced ESL document is 4 liters per minute (L/min) so 0.00044 = 4 L/min / (4 L/min + indoor air flow rate), or indoor air flow rate = 9,000 L/min

---

2 Based upon the risk criteria outlined in the United States Environmental Protection Agency's (EPA's) Risk Assessment Guidance for Superfund Part F (2009), the commercial indoor air screening value is 5 times higher than the residential screening value. For most of the country, the allowed residential benzene indoor air level is 0.31 $\mu g/m^3$ so the commercial value is 0.31 $\mu g/m^3$ * 5 = 1.6 $\mu g/m^3$ (as tabulated in the EPA Region 9 screening levels). However in California, the California Environmental Protection Agency indoor air residential screening level is 0.084 $\mu g/m^3$, so the commercial indoor air screening level is: 0.084 $\mu g/m^3$ * 5 = 0.42 $\mu g/m^3$.

3 Benzene concentration in shallow soil gas from near sub-slab probe SVP-4 on March 30, 2011.

(3) The default commercial indoor air flow used to calculate SVI ESLs in the previously referenced ESL document is 2 air changes/hour = 8,000 L/min; so 9,000 L/min = 2.3 air changes /hour.

The air change rate needed to dismiss benzene SVI is 2.3 air changes/hour, so the minimum air change measurement of 2.64 air changes/hour (pre-HVAC maintenance, with testing performed with the building's HVAC system operating poorly) demonstrates that there is no benzene SVI concern. With the maintenance performed on the HVAC units, and the significant increase in air changes per hour within the building, the potential for SVI is even a lesser concern.

6.0 RECOMMENDATIONS

Residual petroleum hydrocarbon impacts to shallow soils and groundwater underlying the site have been adequately delineated to below ESLs. Testing results indicate that the 7-Eleven convenience store had existing HVAC systems which accommodated a minimum of 2.6 air exchanges per hour under normal operating conditions. Following HVAC system maintenance, the air change rate for the convenience store building was increased to approximately 11.5 air changes per hour. Due to the noted number of air exchanges occurring within the convenience store, and based on the highest benzene concentrations in soil vapor samples collected from near sub-slab soil vapor probes located directly adjacent to the convenience store, there does not appear to be a human health-based risk of potential SVI into the convenience store which would exceed screening levels for commercial building indoor air quality. The site is likely to remain a convenience store with a paved parking lot for the foreseeable future. Thus, there are no existing or potential receptors that are currently or could be reasonably anticipated to be impacted by the residual hydrocarbon impacts to the shallow soils and groundwater underlying the site.

Therefore, on behalf of Shell, CRA respectfully recommends closure of this case. CRA requests that ACEH suspend the groundwater monitoring program during the closure review.

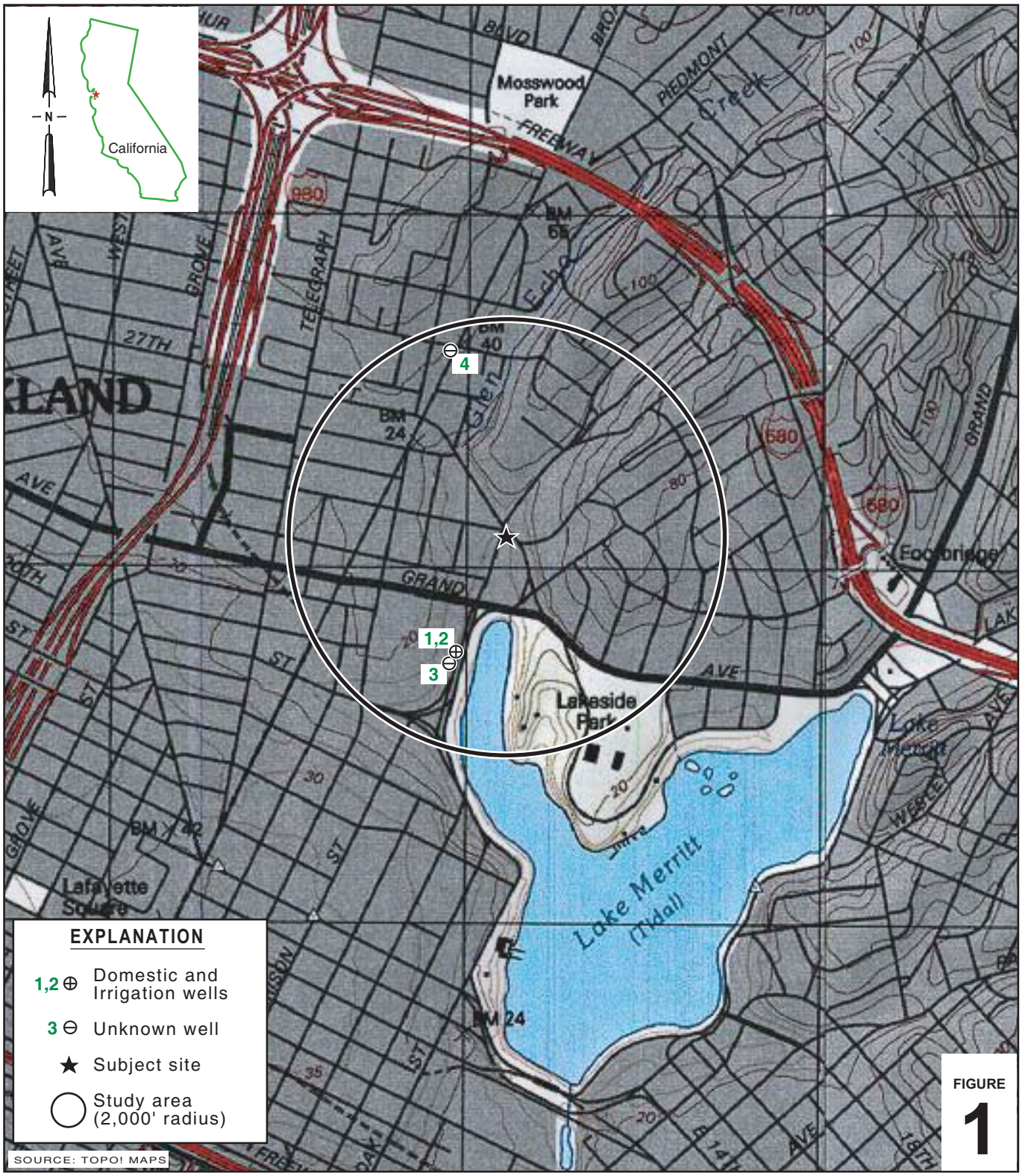
All of Which is Respectfully Submitted,
CONESTOGA-ROVERS & ASSOCIATES

Peter Schaefer, CEG, CHG

Lee Brennan, P.E.

FIGURES

10/31/08



I:\Shell\6-chars\0601-\060119-Oakland 2350 Harrison St\060119-FIGURES\060119 VICINITY.AI

FIGURE
1

0 1/8 1/4 1/2 1

SCALE : 1" = 1/4 MILE

Former Shell Service Station

2350 (2368) Harrison Street

Oakland, California

CONESTOGA-ROVERS & ASSOCIATES

Vicinity Map

10/26/2011

Site Plan

EXPLANATION

- SVP-4 — Near sub-slab soil vapor probe
- B-1 — Soil boring location
- Soil boring location, abandoned after 2' due to utility conflict
- SVP-1 — Soil vapor probe location
- S-1 — Monitoring well location
- Storm drain (STM)
- Sanitary sewer line (SAN)
- Water line (W)
- Electrical line (E)
- Gas line (G)
- Telecommunications line (T)
- Unknown utility line (?), indicated by private utility locator

N

0 5 10 20

Scale (ft)

HARRISON STREET

BAY PLACE

Former Shell Station
2368 Harrison St.

Street Light (typ.)
Planter
Sign
Light Pole
Driveway
Former Dispenser Islands
Former Dispenser Island
Former USTs
Former Waste Oil UST
Former Station Building
Former Tire/Wheel Hoist
Former Drive-on Hoist
Sidewalk
Lamp Post
Fenced Enclosure
SAN
STM
W
E
T
G

S-1 S-2 S-3 S-4 S-5 S-6
B-1 B-2 B-3 B-4
SVP-1 SVP-2 SVP-2a SVP-3 SVP-4 SVP-5

CONESTOGA-ROVERS & ASSOCIATES

Former Shell Service Station
2350 (2368) Harrison Street
Oakland, California

FIGURE
2

I:\Shell\6-chars\0601--\060119-Oakland 2350 Harrison St\060119-FIGURES\060119 SITE PLAN (F2, 10'-SCALE).DWG

APPENDIX A

UNMACK CORPORATION – AIR EXCHANGE MEASUREMENT REPORT

Air Change Rate Measurements
Former Shell Service Station
2350 Harrison Street
Oakland, California

Prepared for

Conestoga-Rovers & Associates
5900 Hollis Avenue, Suite A
Emeryville, CA 94608-2008

Prepared by

Unmack Corporation
1379 Park Western Dive, PMB 282
San Pedro, California 90732-2300
(310) 377-2367 Fax (310) 377-2589

Field Date
December 19, 2011

Report Date
December 29, 2011

Project 3162

Air Change Rate Measurements
Former Shell Service Station
2350 Harrison Street
Oakland, California

Report Signature Page

This report was prepared by the undersigned from information provided by Peter Schaefer, PE, Lee Brennan, and Emerson Baldoz of Conestoga-Rovers & Associates and the results of observations and measurements as detailed herein.

James L. Unmack

James L. Unmack, PE, CIH, CSP
President, Unmack Corporation

12-29-11
Date

Conestoga-Rovers & Associates
5900 Hollis Street, Suite A
Emeryville, CA 94608

SAP Code	173318
Incident Number	97743969
Agency Number	RO0000505
Reference Number	060119 (21)

Air Change Rate Measurements
Former Shell Service Station
2350 Harrison Street
Oakland, California

Table of Contents

Air Change Rate Measurements
Former Shell Service Station
2350 (2368) Harrison Street
Oakland, California

1 INTRODUCTION

At the request of Peter Schaefer, CEG, CHG, Conestoga-Rovers & Associates, consultant, James L. Unmack, PE, CIH, CSP and field technician Ryan Richards, conducted measurements of the air infiltration rates at 2350 Harrison Street, Oakland, California, with the assistance of Emerson Baldoz and Lee Brennan of Conestoga-Rovers & Associates.

2 BACKGROUND

A 7-Eleven convenience store now occupies the lot that once was a Shell Service Station. The impact of soil vapor intrusion on the occupants is mitigated by the air infiltration. Given the contaminants in the soil, the impact on the occupied spaces of the building can be modeled if the air change rate is known.

3 SUMMARY

The air change rate in the structure now occupied by a 7-Eleven convenience store was measured in accordance with the Air Exchange Measurement Work Plan prepared October 12, 2011. On December 19, 2011, carbon dioxide was released into the occupied space and the concentration monitored with TSI Q-Trak indoor air quality instruments. The air change rate was calculated from the rate of decay under two conditions, lesser activity in the store at mid morning and greater activity in the store over the lunch hour. The average of all measurements is 3.11 $\pm$ 0.3 air changes per hour (3.11 ACH). There was more activity in the store over the lunch hour which resulted in more air changes per hour with the main door opening more frequently.

4 METHODS

4.1 Air Change Rate

The air change rate was measured by monitoring the concentration of a tracer gas as it is diluted by outside air as it infiltrates the space to be measured. Carbon dioxide was used as the tracer gas. Carbon dioxide concentration was monitored with TSI Q-Traks, serial numbers 8554-01051027, 8554-01051026, and 8551-52046. The Q-Trak uses a non-dispersive infrared (NDIR) sensor for carbon dioxide measurement. The infiltration rate is calculated as a first order exponential decay given by the following equation:

$$C_t = C_o\, e^{-kt} \tag{1}$$

In this equation, k represents the rate of decay of the concentration of the tracer gas and is given by the rate of air flowing out of the room divided by the volume of the room. Q is the rate of air out of (or into) the room and V is the volume of the room.

$$k = \frac{Q}{V} \tag{2}$$

Alternatively, the value of k can be calculated by solving the first order differential equation for the decay of the concentration of the tracer gas as follows:

$$k = \frac{1}{(t_t - t_o)} \left(\ln (C_t - C_b) - \ln (C_o - C_b)\right) \tag{3}$$

where C_b is the background, ambient concentration of carbon dioxide and k is the infiltration rate divided by the volume of the space and represents the number of air changes per unit of time. The background concentration of carbon dioxide in the ambient air is subtracted from the concentration of carbon dioxide tracer gas.

4.2 Air Change Rate by Regression Method

The air change rate can also be estimated by performing a regression on the natural logarithm of the tracer gas concentration, C_i, as a function of time using the normal equations:

$$\sum_{i=1}^{n} y_i = an + b \sum_{i=1}^{n} x_i \tag{4}$$

$$\sum_{i=1}^{n} x_i y_i = a \sum_{i=1}^{n} x_i + b \sum_{i=1}^{n} x_i^2 \tag{5}$$

where

$$y_i = \ln(C_{(t)i}) \tag{6}$$

$$x_i = t_i \tag{7}$$

and b corresponds to the air change rate.

The measurements were performed under the conditions that normally exist in the occupied space, that is, the normal operation of convenience store was disturbed as little as possible. Using carbon dioxide as the tracer gas, the gas was released rapidly into the space to be tested while monitoring the gas concentration to stay below the 8-hour time weighted average permissible exposure limit of 5000 ppm.

4.3 Air Flow

Air velocity was determined with a Dwyer Thermoanemometer. Average velocities for the air stream were computed and used in the following equation to determine air flow.

$$Q \text{ (cubic feet per minute)} = A \text{ (square feet)} \times V \text{(feet per minute)} \quad (7)$$

4.4 Temperature and Humidity

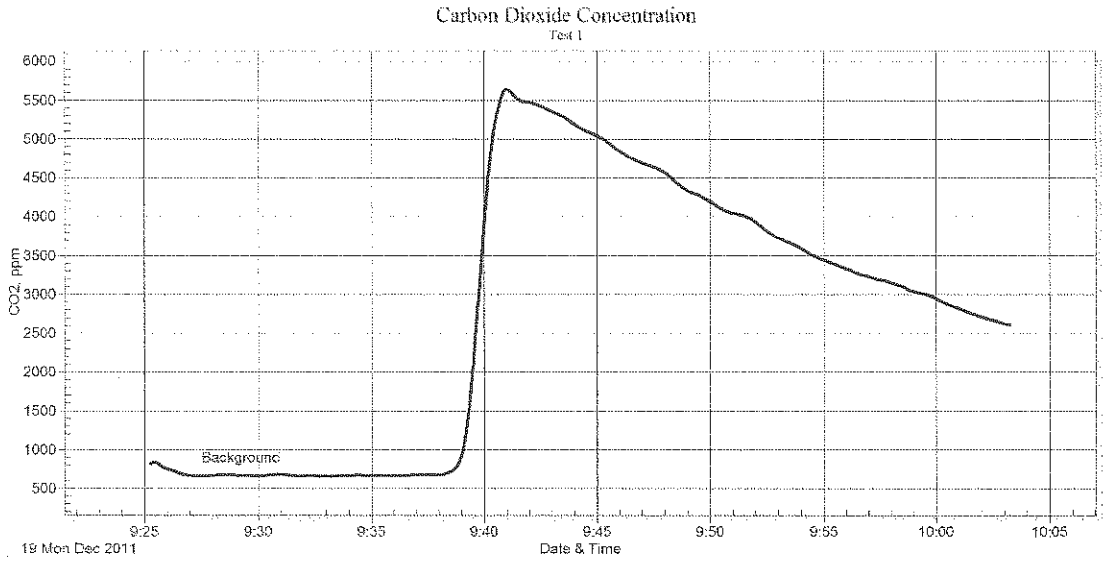
Temperature and relative humidity were recorded along with carbon dioxide on the Q-Trak.

5 RESULTS

5.1 Air Exchange Rate by Carbon Dioxide

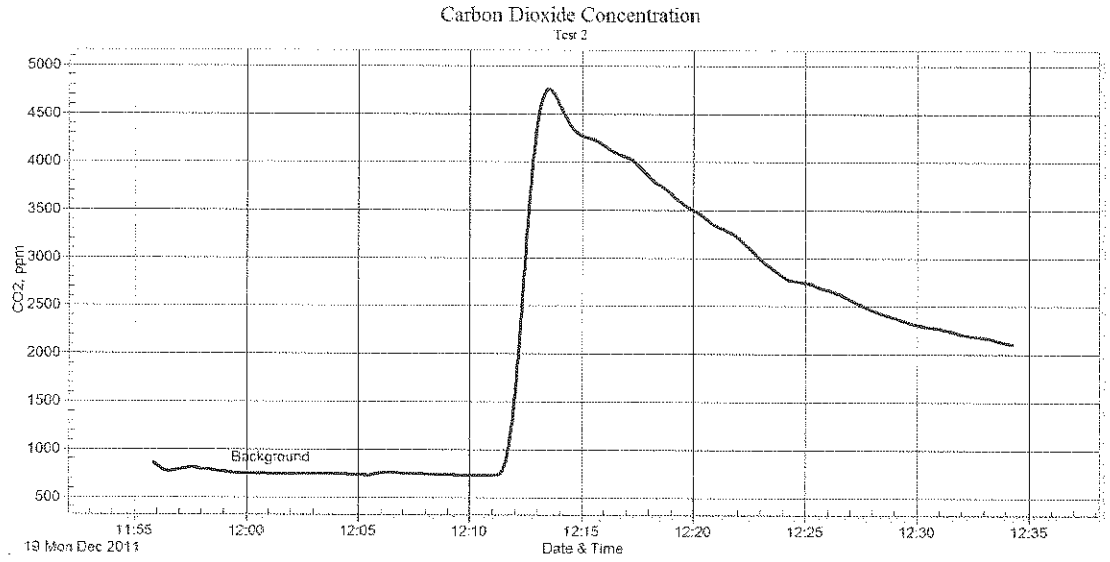
On December 19, 2011, approximately 10 pounds of carbon dioxide were released from a 20-pound cylinder into the space to be measured for each test. After allowing time for mixing and the concentration to decay, the concentration and time were recorded. Figure 5-1 shows the decay of the tracer gas concentration.

Figure 5-1 Test 1, Mid Morning



The measurement was repeated over the lunch hour when more activity in the store would change the results. Figure 5-2 shows the rate of decay of the tracer gas concentration not significantly different at mid day compared to mid morning.

Figure 5-2 Test 2, Lunch Hour



5.2 Air Exchange Rate by Average

The air change rate was measured at two different periods during the day to determine the effect of activity in the store on the air change rates. No appreciable difference was seen between mid morning and mid day. Three Q-Trak datalogging instruments recorded carbon dioxide concentration. The results represent the average of the three Q-Traks.

A first estimate of the air change rate is obtained by equation (3), a method that gives the average air change rate. The results of averaging are shown in Table 5-1.

Table 5-1 Air Change Rates by Averaging

Test Conditions	Q-Trak 52046 Behind Counter	Q-Trak 51026 Center of Store	Q-Trak 51027 Back of Store	Average Air Change Rate
Mid morning, low activity	3.11	2.55	2.60	2.75
Mid day, lunch hour	3.41	3.04	2.79	3.08

5.3 Air Change Rate by Regression Analysis

A least squares regression was performed on the data collected from the gas monitors. The air change rates determined by regression are considered more accurate than the air change rates determined by the averaging method.

Table 5-2 Air Change Rates by Regression

Test Conditions	Q-Trak 52046 Behind Counter	Q-Trak 51026 Center of Store	Q-Trak 51027 Back of Store	Average Air Change Rate
Mid morning, low activity Manual recording	3.04	3.04	2.82	2.97
Mid morning, low activity Data logged	2.82	2.64	2.80	2.75
Mid day, lunch hour Manual recording	3.59	3.59	3.19	3.46
Mid day, lunch hour Data logged	3.34	3.20	3.24	3.26

5.4 Air Change Rate by Air Flow Measurement

Air flows were measured through the main entry door. The air change rate is given by equation (2). The variability in the airflow measurements is mainly from the turbulence and gusty nature of the natural wind. Using the average of the measurements as the best estimate of the true value, the estimated air change rate that would occur if the main customer entry door is kept open is shown in table 5-3 below.

Table 5-3 Airflow Measurements

Location	Area (ft^2)	Average Velocity (ft/min)	Airflow (ft^3/min)	Air Change Rate (hr^{-1})
Main Customer door (6 ft x 7 ft)	42	52	2190	11.6

6 DISCUSSION

In the convenience store the main customer entry doors are normally closed. The source of air infiltration is mainly the two package HVAC units on the roof. The amount of airflow supplied by the package HVAC units was not measured directly.

7 RECOMMENDATION

Natural ventilation rates depend on weather conditions. To ensure a minimum number of air changes per hour, mechanical ventilation should be operated during occupancy. The airflow for the mechanical ventilation can be determined by equation (8).

$$Q = k\,V \tag{8}$$

The measured volume of the room is 11,400 ft^3. For a minimum of 4 air changes per hour, the HVAC units need to supply at least 760 ft^3/min.

8 CONCLUSION

The two package HVAC units on the roof provide fresh air to the store to achieve 3 air changes per hour.

9 REFERENCE

ASTM E741-00 Standard Test Method for Determining Air Change in a Single Zone by Means of a Tracer Gas Dilution.

Certificate Number: 115161
Calibration Date: 16 December 2011

Ashtead TECHNOLOGY

Calibration Certificate

Asset No:	**R3179**
Description	**TSI 8551 Q-TRAK W/CO IAQ**
Serial No:	**50806**
Manufacturer:	**TSI**
Calibration Date:	**16 December 2011**
Next Calibration:	**Refer to Manufacturers Instructions**
Accuracy of Unit Under Test:	
Adjustments made:	**None**
Calibration Technician:	**Brian Floyd**

Details of any limitations to the use of the equipment
None

The following measurement equipment used during the calibration procedure is traceable to National Standards.

Measurement Equipment/Standards	**Reference**
EGG 2002 W/S1 SENSOR - 27578	280873-11
50 PPM CARBON MONOXIDE - 933707	933707
ZERO AIR - 939140	939140
1900 ppm Carbon Dioxide - 936749	936749

Calibrated By: B. Floyd

Brian Floyd

EQUIPCO RENTALS

TSI Model 8554 Q-TRAK
CALIBRATION CERTIFICATE

DATE: 12/16/11 CALIBRATED BY: CAF

RENTAL I.D.: Q-TRAK. 07

SERIAL NO.: 8554-07051026

CALIBRATION GAS 1 : 99.8% Nitrogen (0ppm CO_2, 0ppm CO) Lot#: 10510252936I-3

RESPONSE TO GAS 1: 0 ppm CO_2

0 ppm CO

CALIBRATION GAS 2: Carbon Dioxide 10000 ppm Lot#: 91963100S

RESPONSE TO GAS 2: 10000 ppm ± 3%

CALIBRATION GAS 3: Carbon Monoxide 95 ppm Lot#: 91963100S

RESPONSE TO GAS 3: 95 PPM ±3%

THIS INSTRUMENT HAS BEEN CALIBRATED TO MEET FACTORY SPECIFICATIONS

2100 Meridian Park Blvd, Concord, CA. 94520 Phone (888) 234-5678 Fax (925) 674-8655

EQUIPCO RENTALS

TSI Model 8551 Q-TRAK
CALIBRATION CERTIFICATE

DATE: 12/16/11 CALIBRATED BY: [signature]

RENTAL I.D.: Q-TRAK.008

SERIAL NO.: 8554-01051027

CALIBRATION GAS 1 : 99.8% Nitrogen (0ppm CO_2, 0ppm CO) Lot#: 051025293613

RESPONSE TO GAS 1: 0 ppm CO_2

0 ppm CO

CALIBRATION GAS 2: Carbon Dioxide 10000 ppm Lot#: 91963105

RESPONSE TO GAS 2: 10000 ppm ± 3%

CALIBRATION GAS 3: Carbon Monoxide 95 ppm Lot#: 91963105

RESPONSE TO GAS 3: 95 PPM ±3%

THIS INSTRUMENT HAS BEEN CALIBRATED TO MEET FACTORY SPECIFICATIONS

2100 Meridian Park Blvd, Concord, CA. 94520 Phone (888) 234-5678 Fax (925) 674-8655

APPENDIX B

B.A. MORRISON – HVAC UNIT MAINTENANCE REPORT

Faxed

B.A. MORRISON

GENERAL CONTRACTOR & HEATING/AIR SPECIALIST

LIC. #603913

February 29, 2012

Conestoga-Rovers & Associates
5900 Hollis Street
Suite A
Emeryville, CA 94608

VIA FAX: 510-420-9170 (originals via u.s. postal service)

RE: Inspection Report - 2350 Harrison Street, Oakland (7-11 Station)

System #1: Model – G.E. BTC048D30AS0, Serial #264235722
(IDB – 3.987, ODF1 – 1.2, ODF2 – 1.3, Comp – 10.9) All within manufacturer's specs

System in poor shape. Filters completely clogged and falling apart. Evaporator very dirty, restricting air flow. Condensate pan full of mud and not draining. Due to clogged condensate, water has been sitting in blower area. All insulation in blower area should be replaced. Blower wheel is rusted out and should be replaced. Motor was installed incorrectly in blower bracket; screws were installed through bracket and housing of blower to secure motor. We recommend replacing blower motor, wheel, and bracket. Also found failed heat strip in system. System appears to only be used in a/c, but we recommend replacing heat strip to allow for full operation of system. Compressor contactor was very pitted and should be replaced.

System #2: Model – G.E. BTC048D30AS1, Serial #230877731
(IDB – 4.4, ODF1 – 1.3, ODF2 – 1.1, Comp – 10.3) Manufacturer's specs IDB = 3.0 amps, rest are within manufacturer's specs

System in very poor shape. Filters completely clogged and falling apart. Evaporator very dirty, restricting air flow. Condensate pan not draining. Water has been sitting in blower area. All insulation should be replaced. IDB is over-amping and could fail at any time; we recommend replacing. Compressor contactor very pitted and should be replaced.

We are in the process of acquiring pricing for replacement parts and will forward proposal for recommended repairs promptly.

Should you have any questions or require additional information, feel free to call our office.

Sincerely,

Randy Walker
Senior Service Technician

(510) 538-9817 Fax (510) 538-0160 2544 Castro Valley Blvd. Castro Valley, Ca 94546

APPENDIX C

CARTER AIR BALANCE COMPANY – AIR CHANGE MEASUREMENT REPORT

Carter Air Balance Company

2127 Main Street

Napa, California 94559

License # 725518

Phone: 707-252-4859 / Fax: 707-252-8351

February 29, 2012

Conestoga-Rovers & Associates (CRA)
5900 Hollis St. – Suite A
Emeryville, Ca. 94608
Attn: Emerson Baldoz

Subject: **Seven-Eleven Store @ 2350 Harrison St. – Oakland**

Emerson:

1. Our scope of work was to establish how many air changes were inside this store per NEBB 6.5.3 & ASHRAE 62-2001 procedural standards.
2. There are only two existing AC units in the store.
3. We used an Alnor Flow Hood to achieve the supply & return air totals of both units.

The stores cubic feet was determined by measuring the length, width & height of the conditioned space. The industry standard for calculating air changes is as follows:

- $\frac{\text{CFM x 60}}{\text{Room Volume}}$ = Air Changes

- Inside store measures 59 ft. x 19 ft. x 10 ft. 2inches = 11434 cubic ft.
- Tested total supply airflow from both ac units = **4480 cfm**

- $\frac{4480 \text{ x } 60}{11434}$ equals **23.50** air changes of supply airflow

- $\frac{2190 \text{ x } 60}{11434}$ equals **11.49** air changes of return airflow

If you have any questions please give me a call at your convenience.

Thanks,

Victor J. Congi
NEBB Certified Professional