



Ground-Level Monitoring Committee Meeting

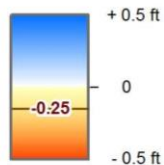
July 27, 2017

Agenda

- ▶ Review: draft *2016 Annual Report of the Ground-Level Monitoring Committee*
- ▶ Discuss: Ground-Level Monitoring Program activities for FY 2017-18
 - Northwest MZ-1
 - Long-Term Pumping Test in the Managed Area

Vertical Ground Motion across Western Chino Basin 2011-2016

Relative Change in Land Surface Altitude
as Measured by InSAR
(March 2011 to January 2017)

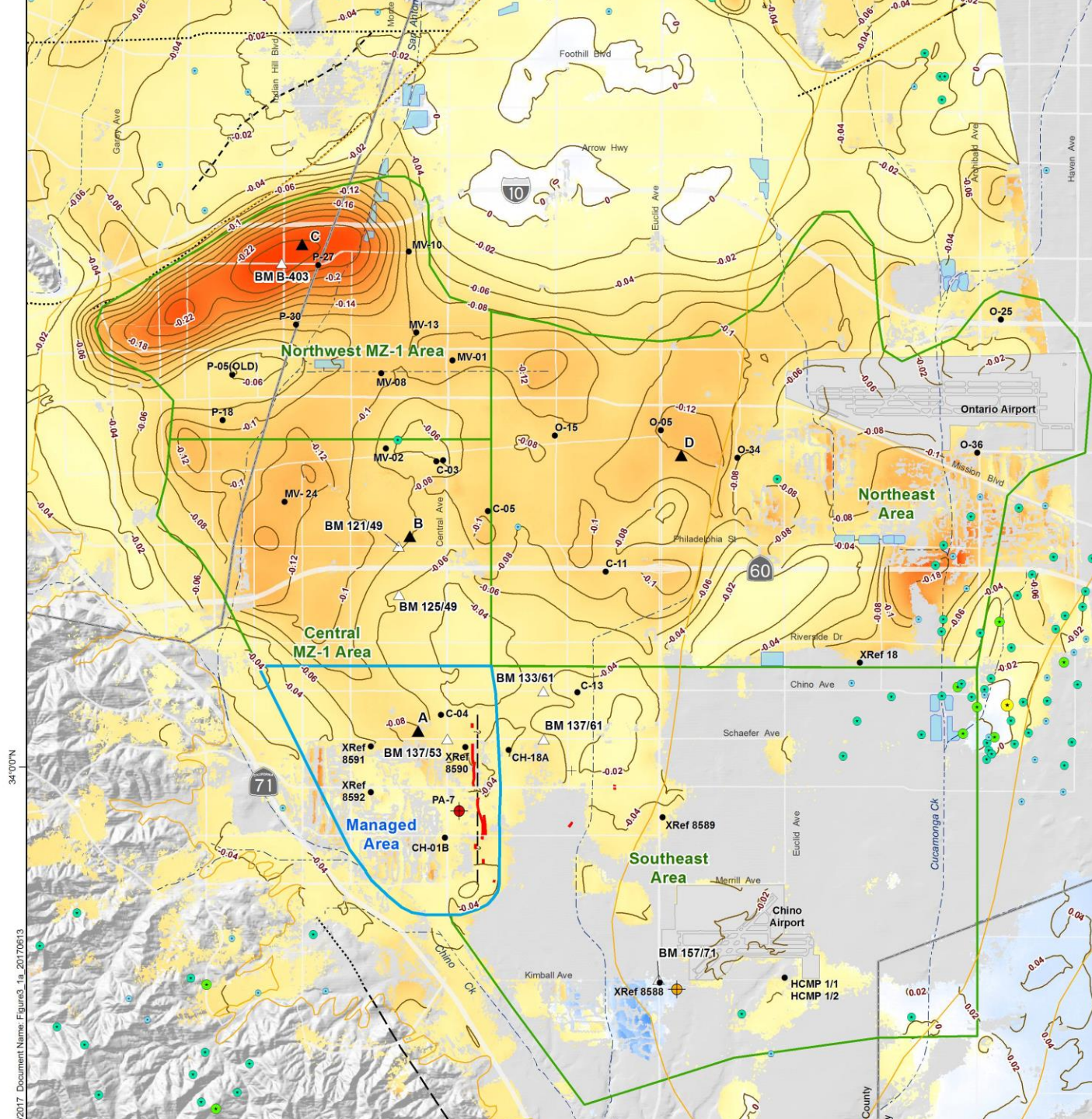


InSAR absent or incoherent

-  Ayala Park Extensometer
-  Chino Creek Extensometer
-  Ground Fissures

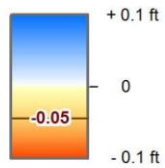
Earthquake Epicenters
March 2011 to January 2017
(Local Magnitude)

-  0 - 1
-  1 - 2
-  2 - 3
-  3 - 4
-  4 - 5
-  5 - 6



Vertical Ground Motion across Western Chino Basin 2016

Relative Change in Land Surface Altitude
as Measured by InSAR
(January 2016 to January 2017)

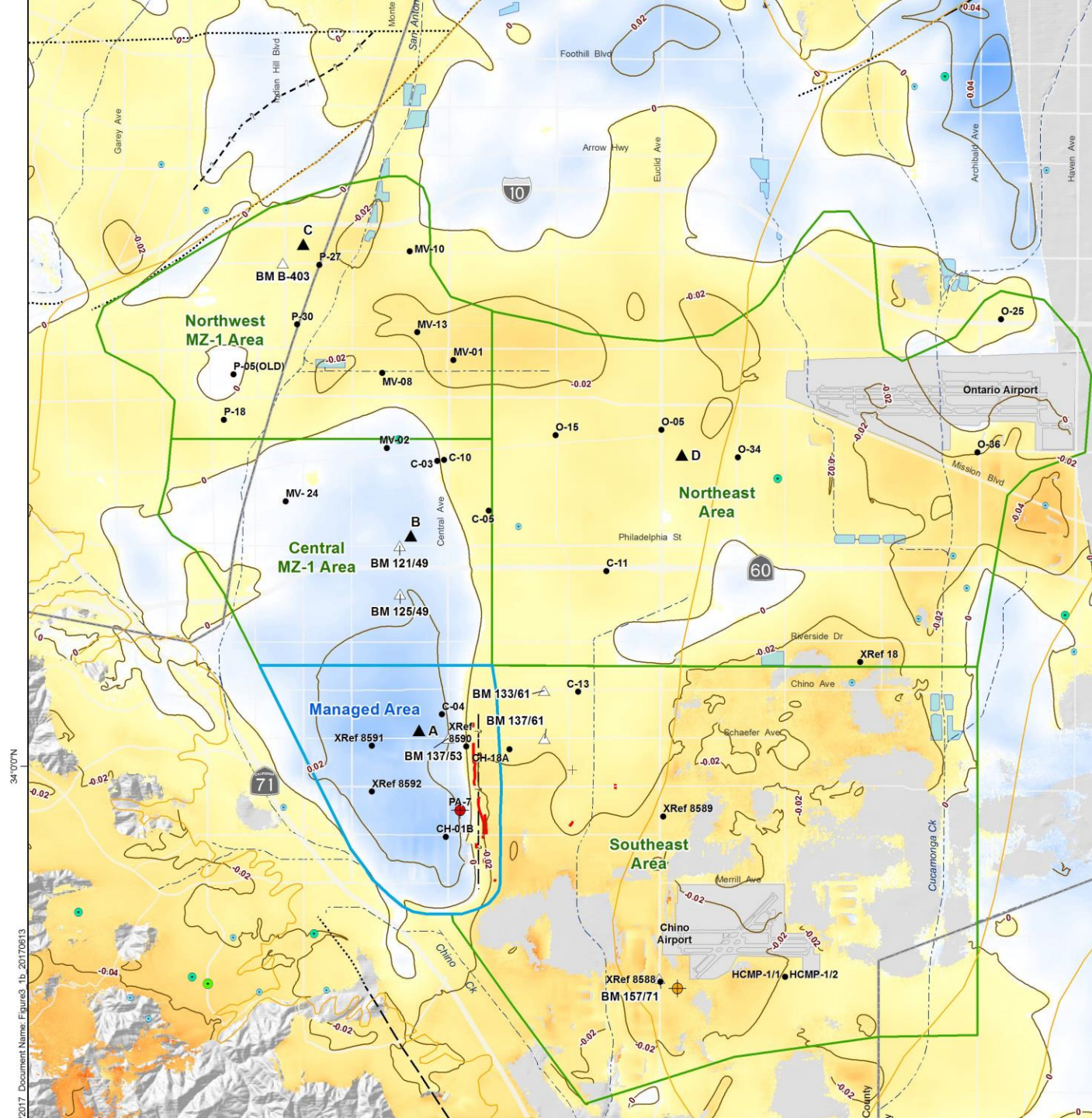


InSAR absent or incoherent

- Ayala Park Extensometer
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Earthquake Epicenters
January 2016 to 2017
(Local Magnitude)

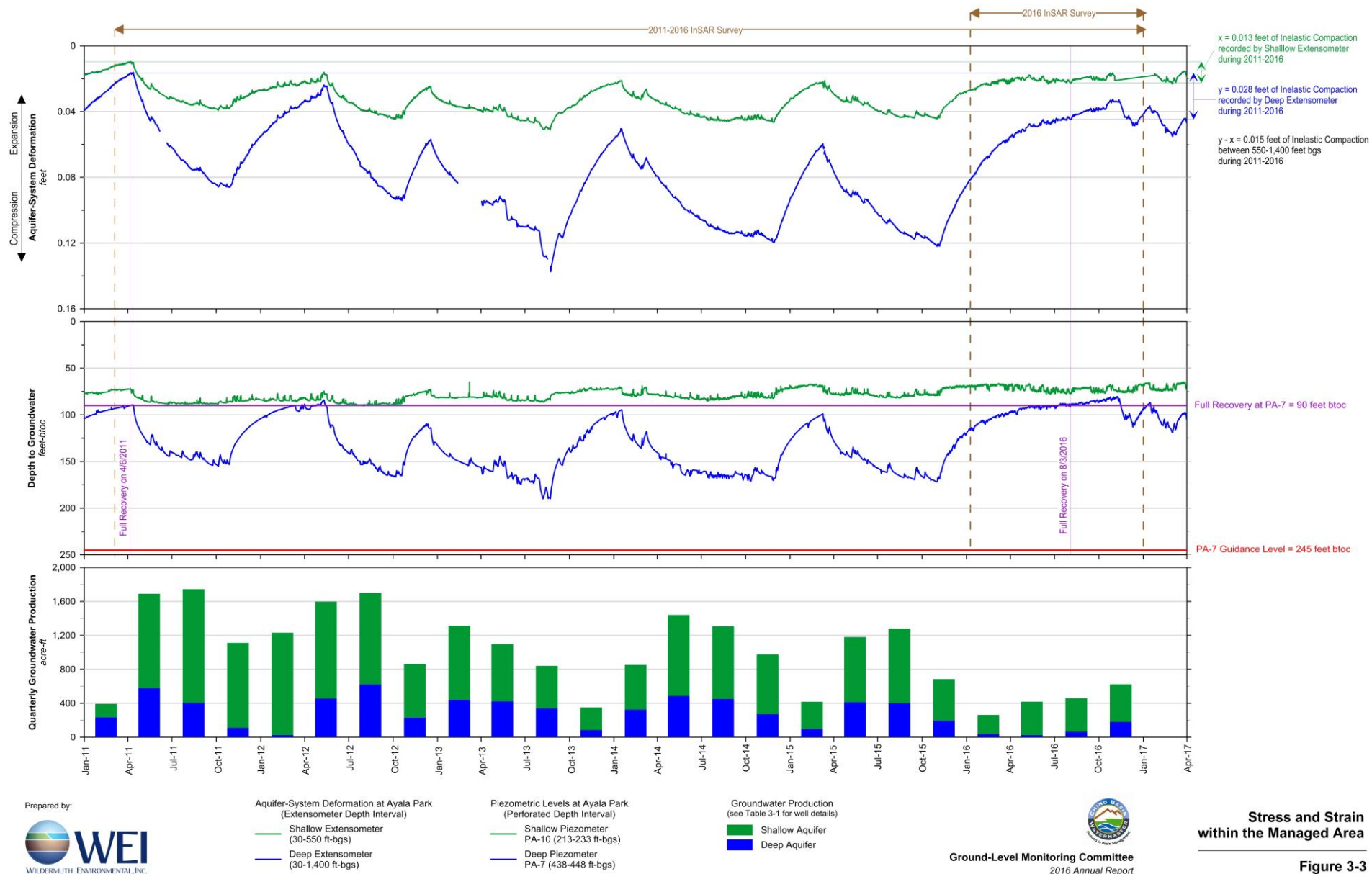
- 0 - 1
- 1 - 2
- 2 - 3
- 3 - 4
- 4 - 5
- 5 - 6

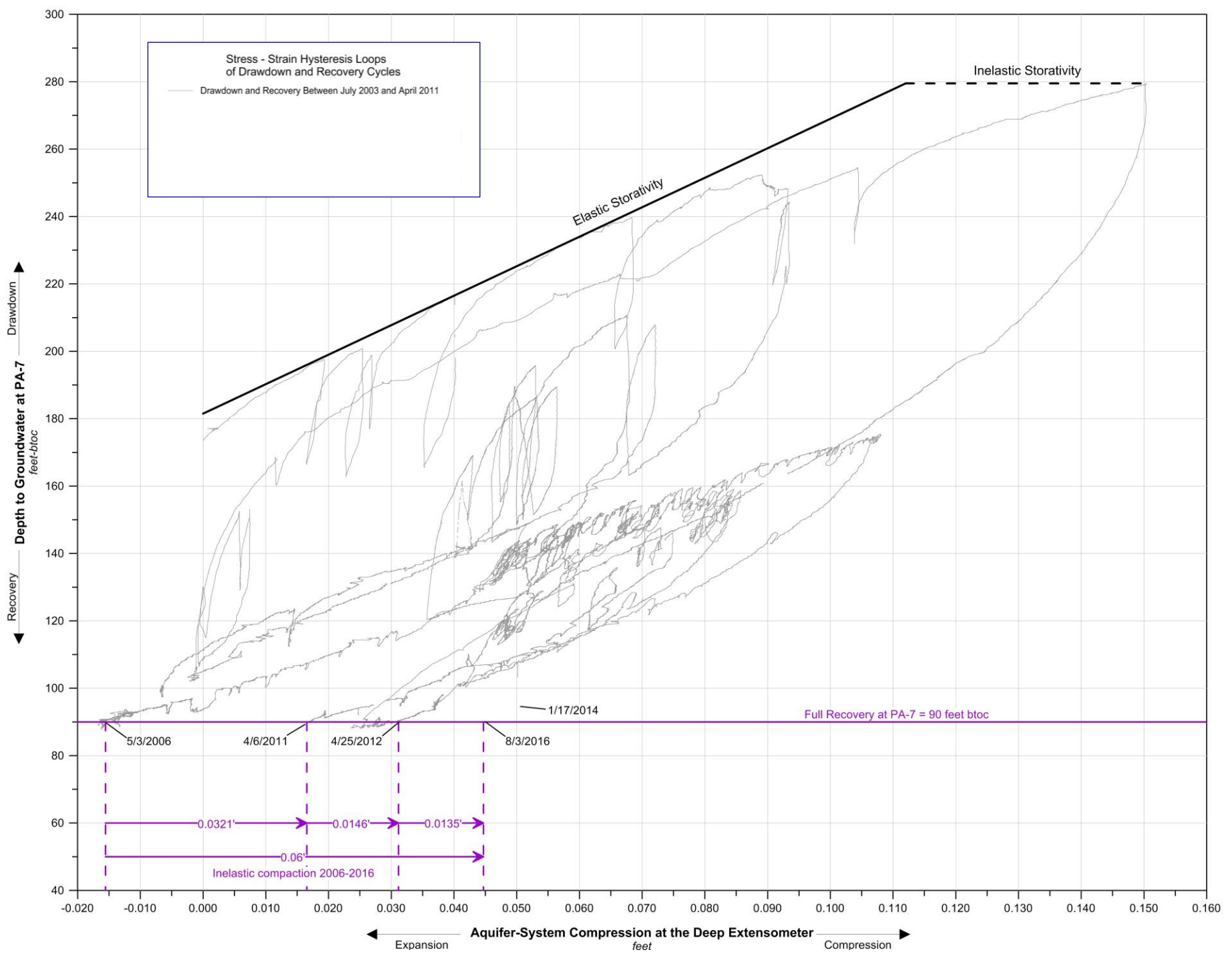


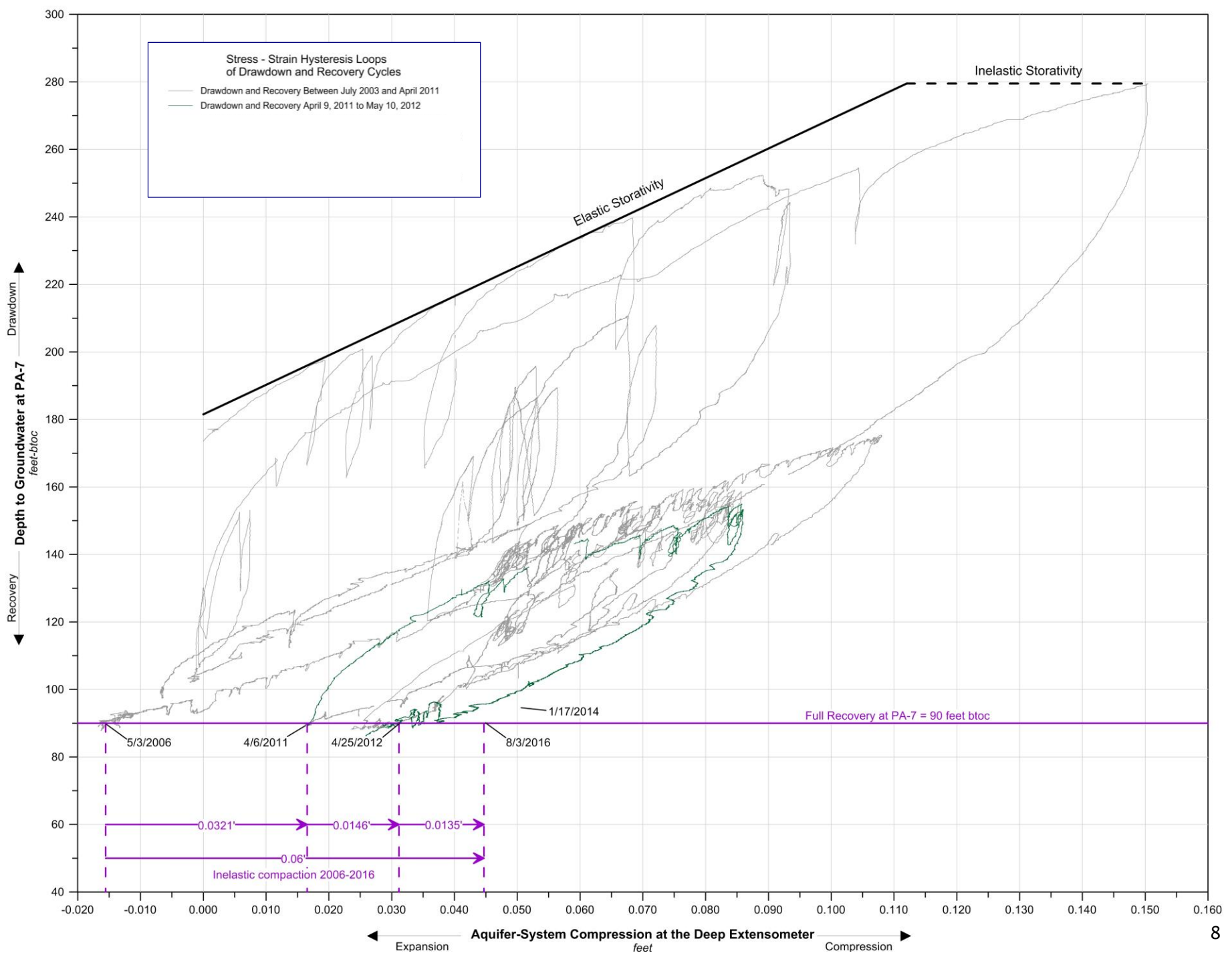
Conclusions and Recommendations:

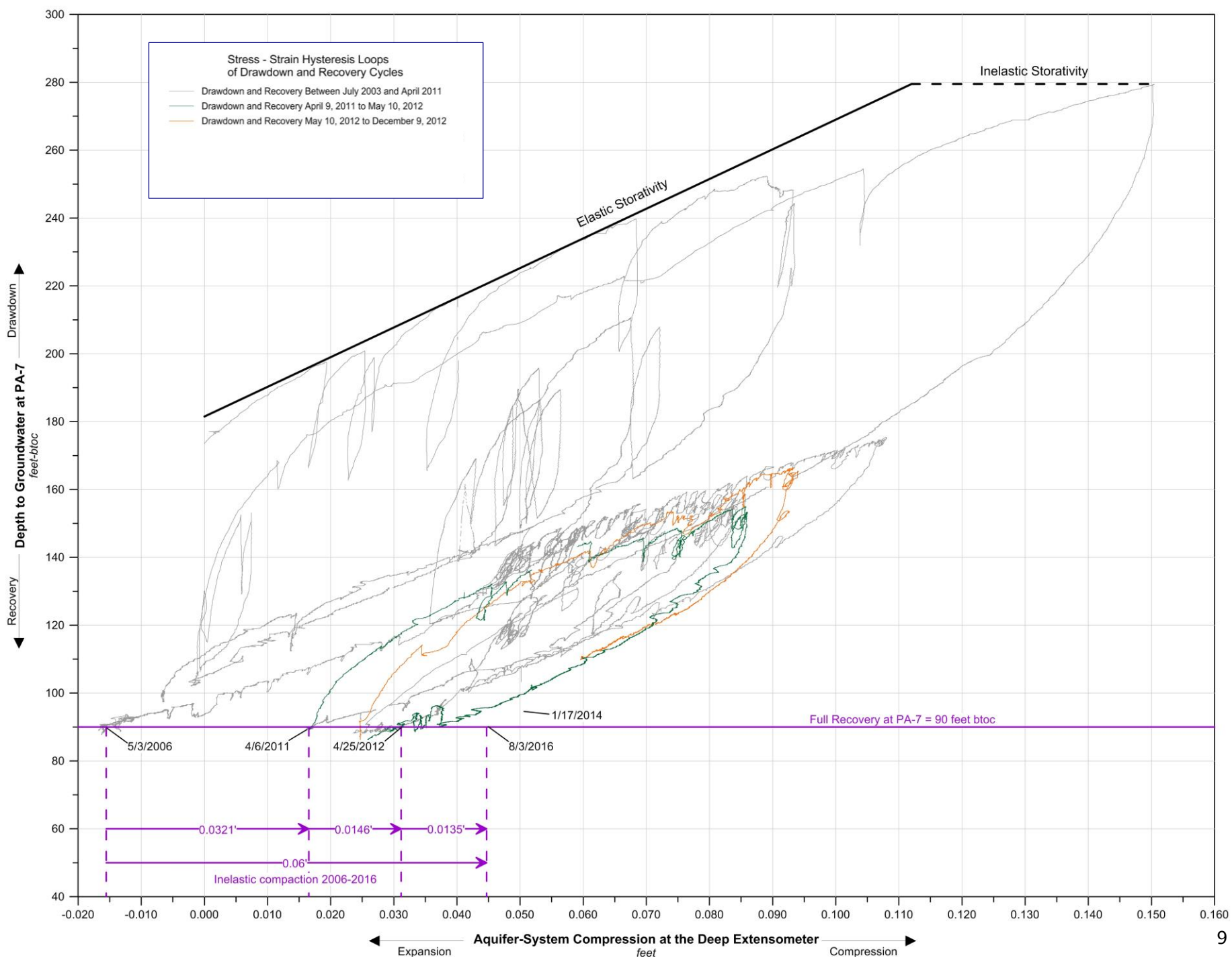
Managed Area

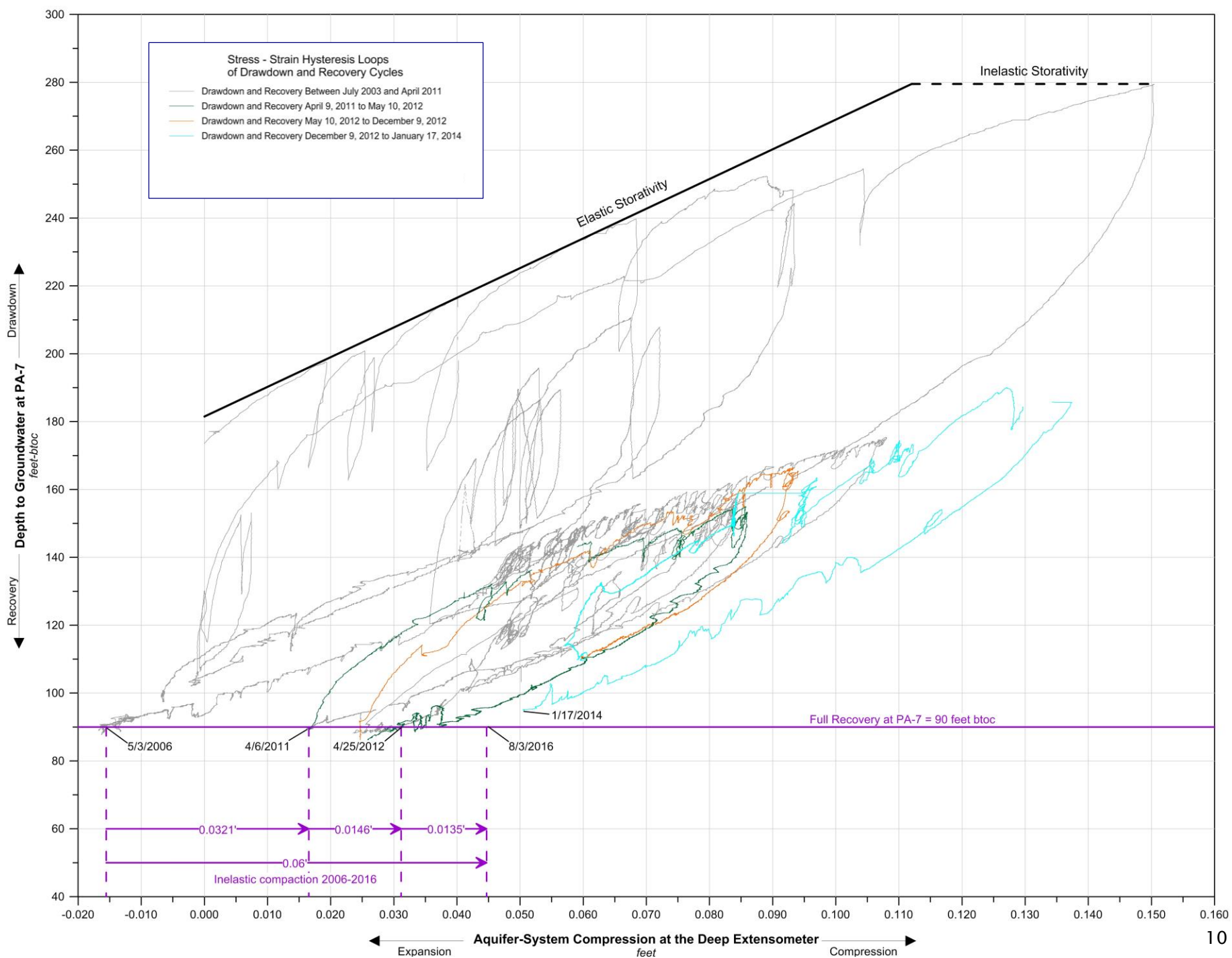
- ▶ During 2016, piezometric-levels at PA-7 did not decline below the Guidance Level of 245 ft-btoc, and the aquifer-system deformation at Ayala Park was elastic
 - Guidance Criteria have been protective in this portion of the Managed Area
- ▶ The recovery of piezometric levels at PA-7 to above 90 ft-btoc in 2016 represented “full recovery” of piezometric levels at PA-7 as defined in the SMP.
 - First instance of full recovery since 2012 → complies with the SMP for full recovery at least once every five years

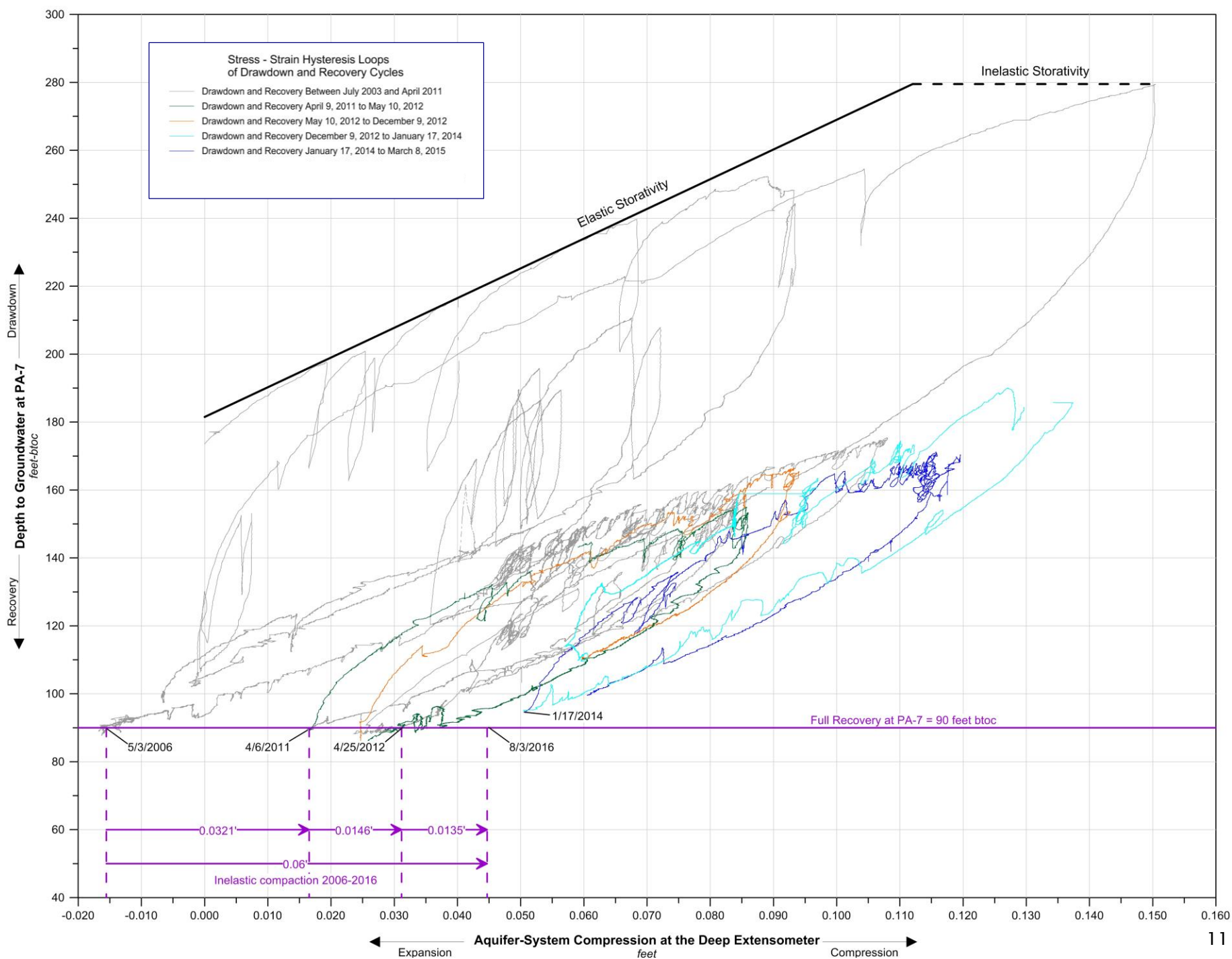


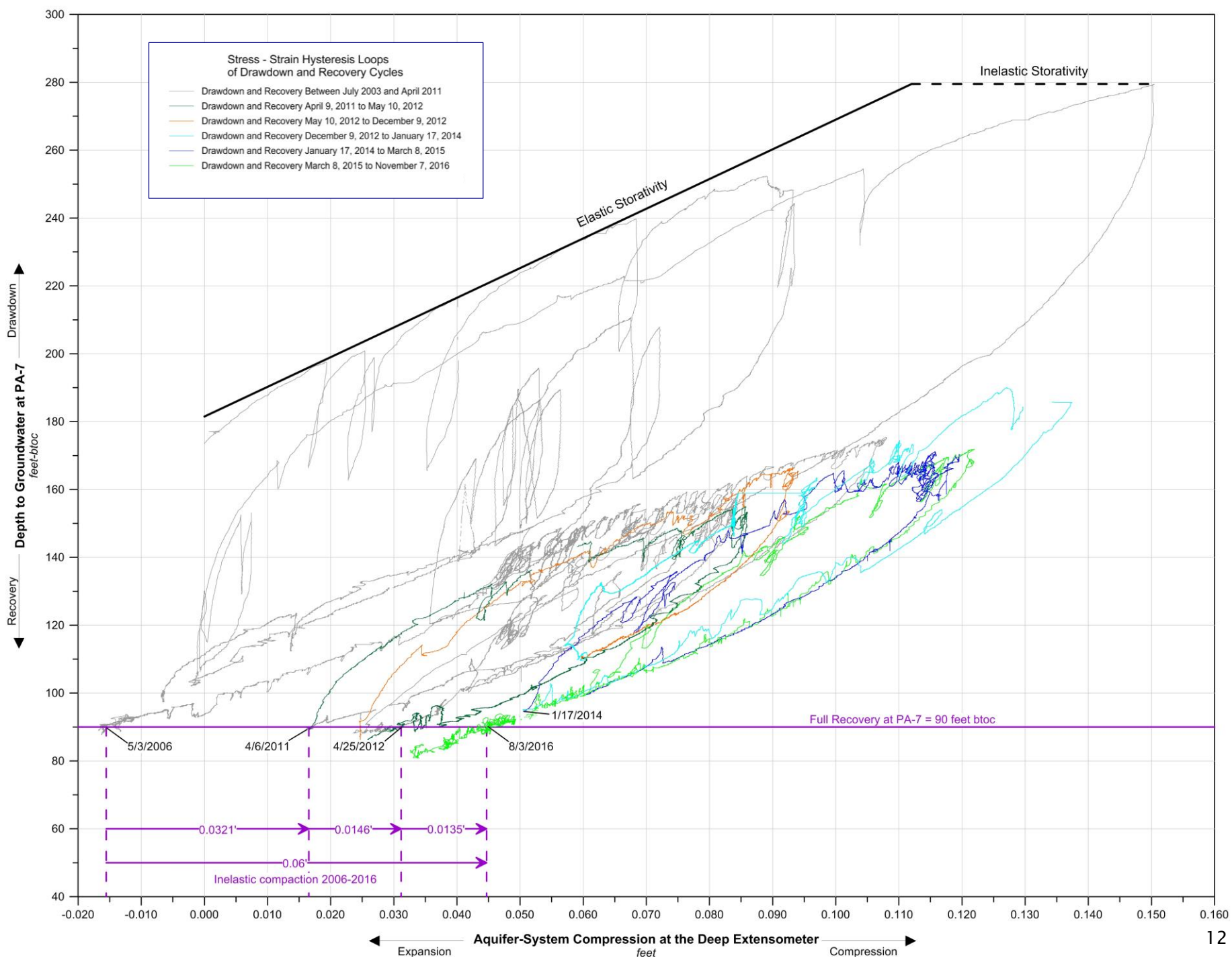


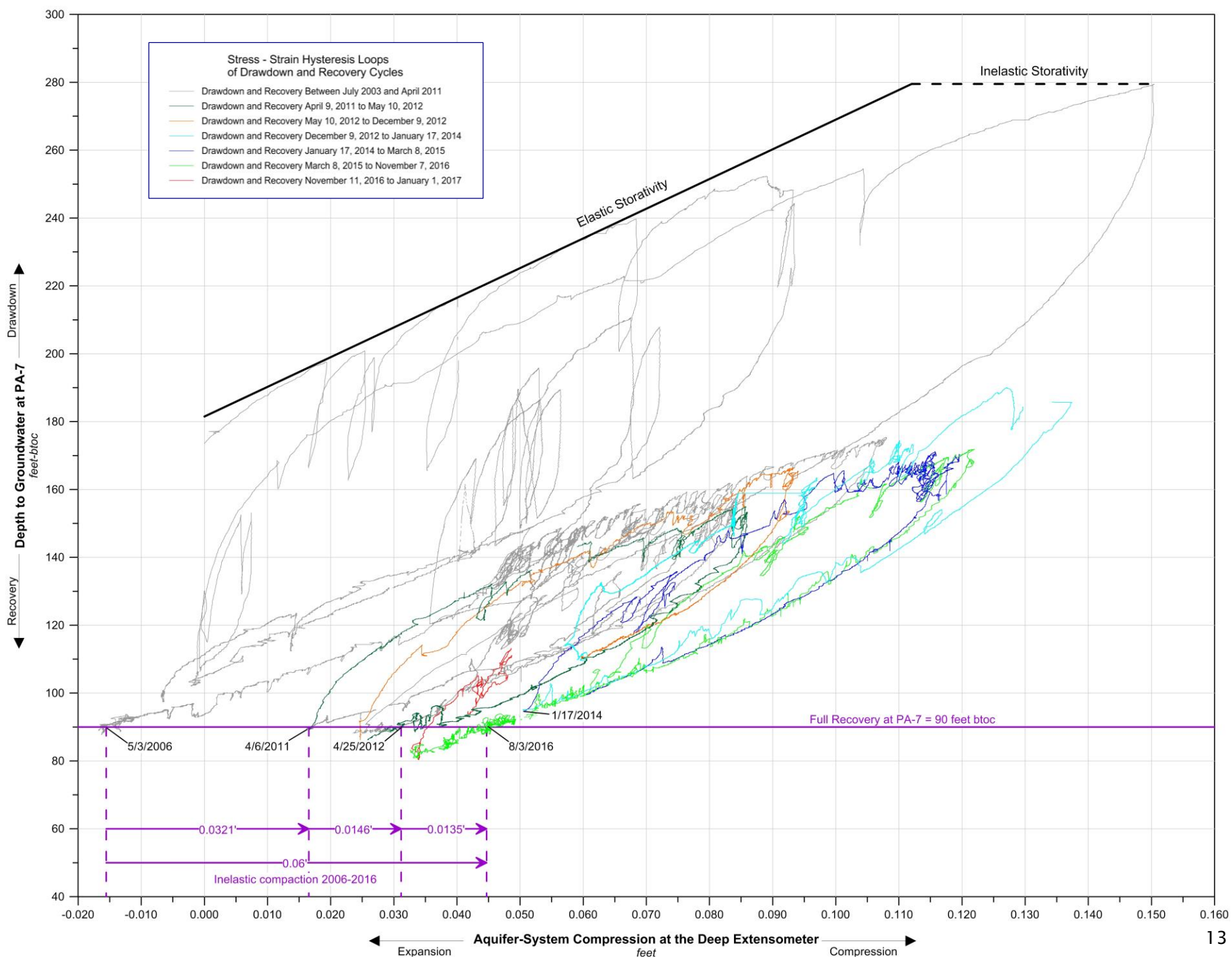




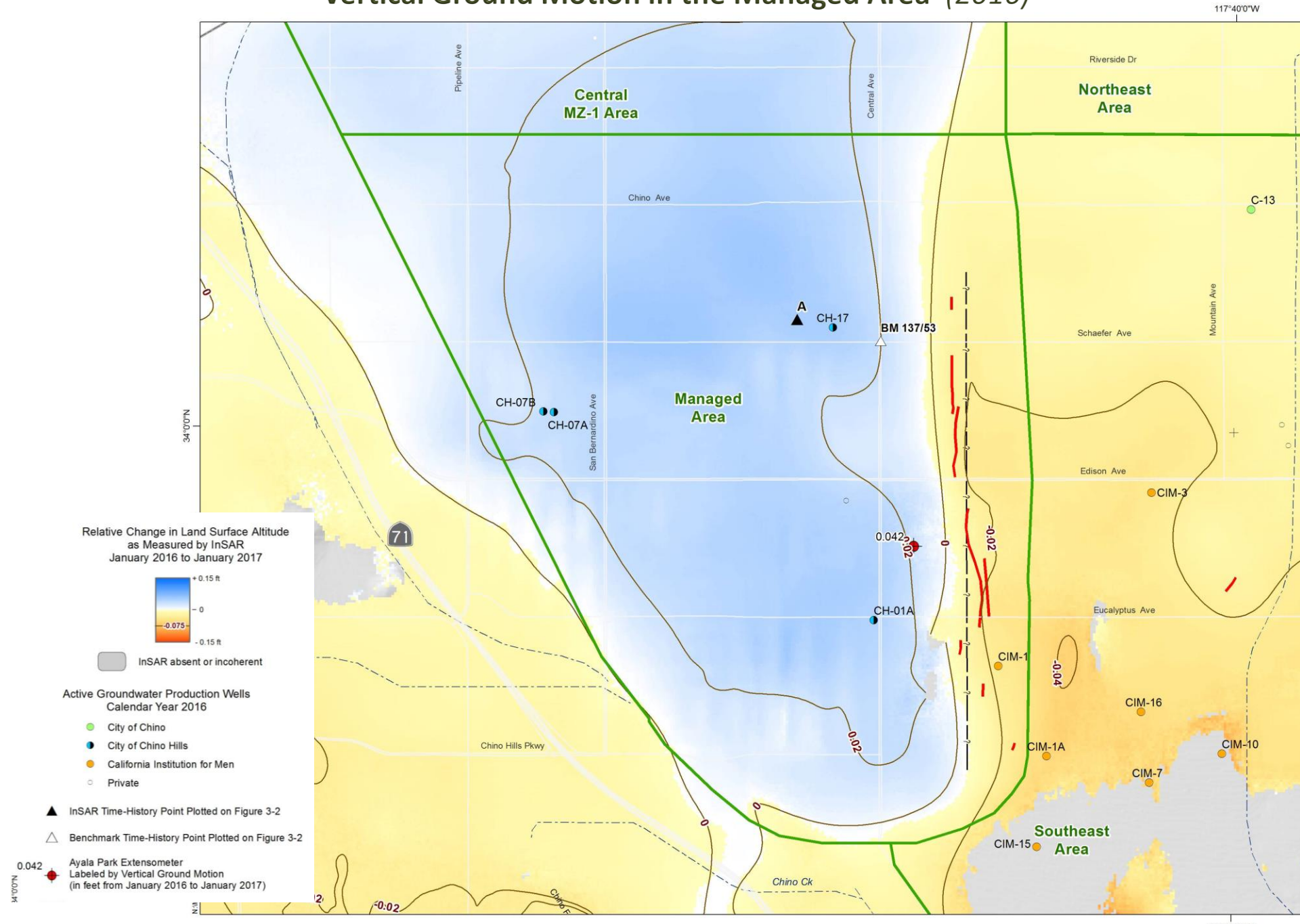








Vertical Ground Motion in the Managed Area (2016)

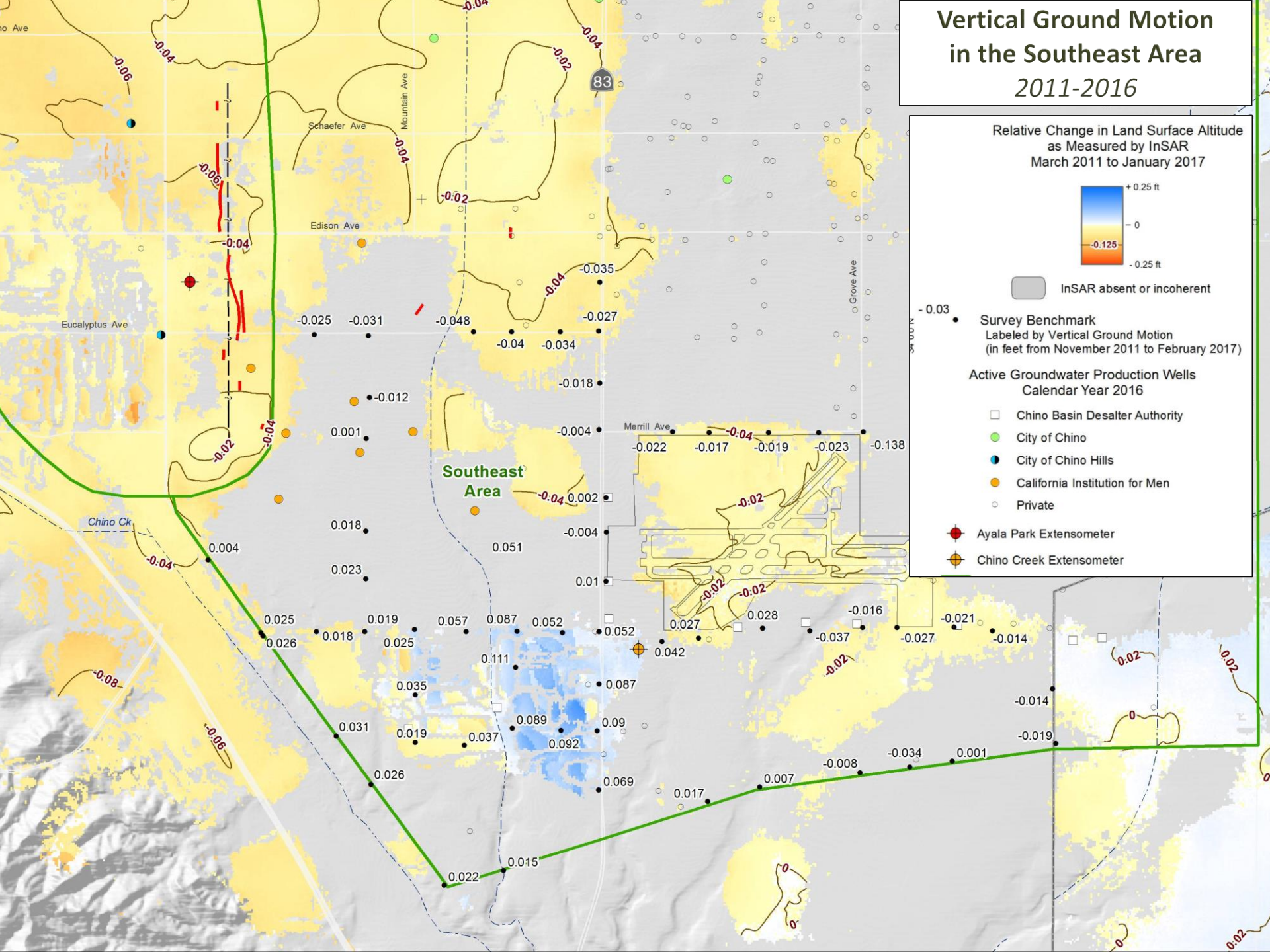


Conclusions and Recommendations:

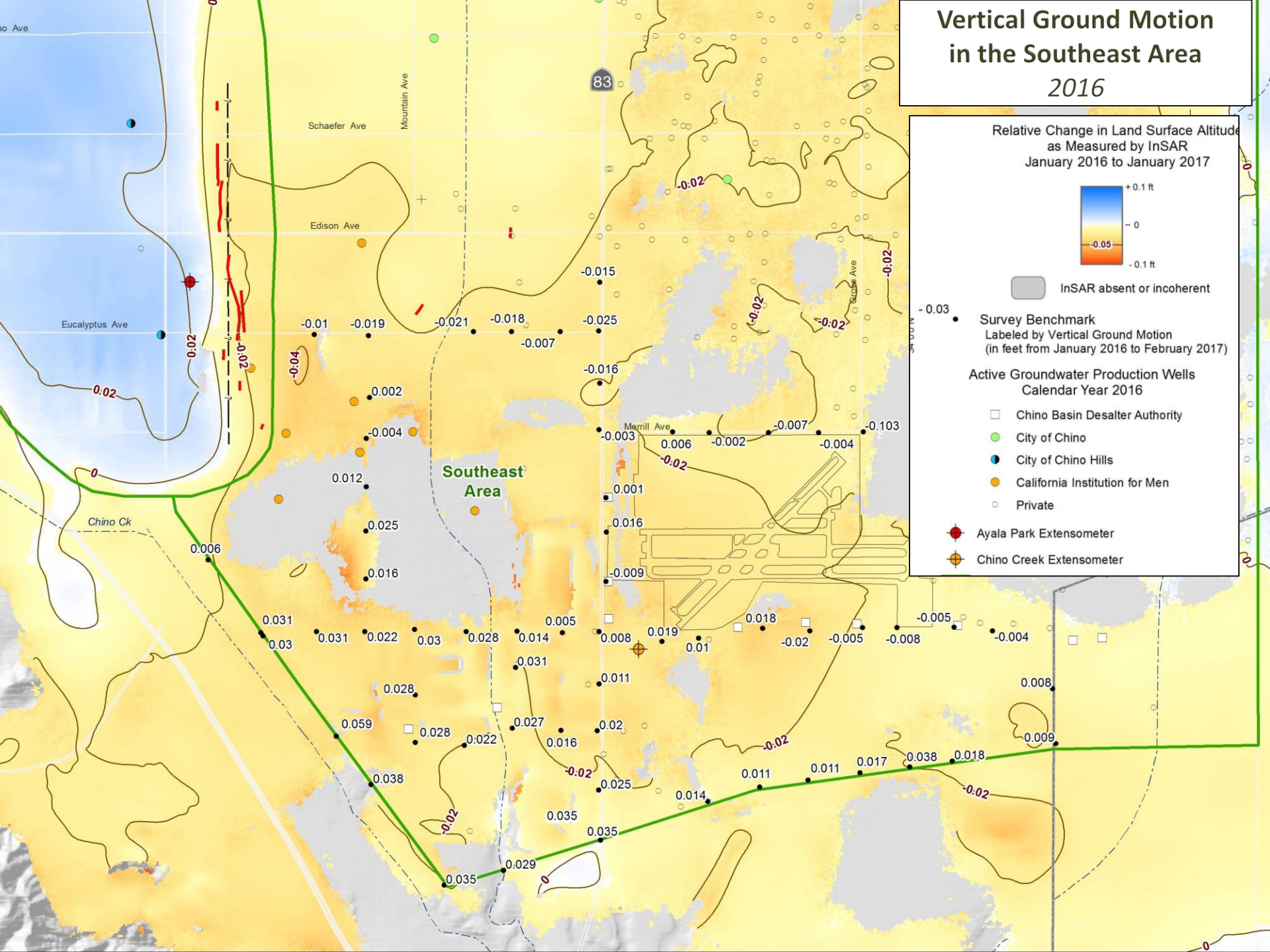
Southeast Area

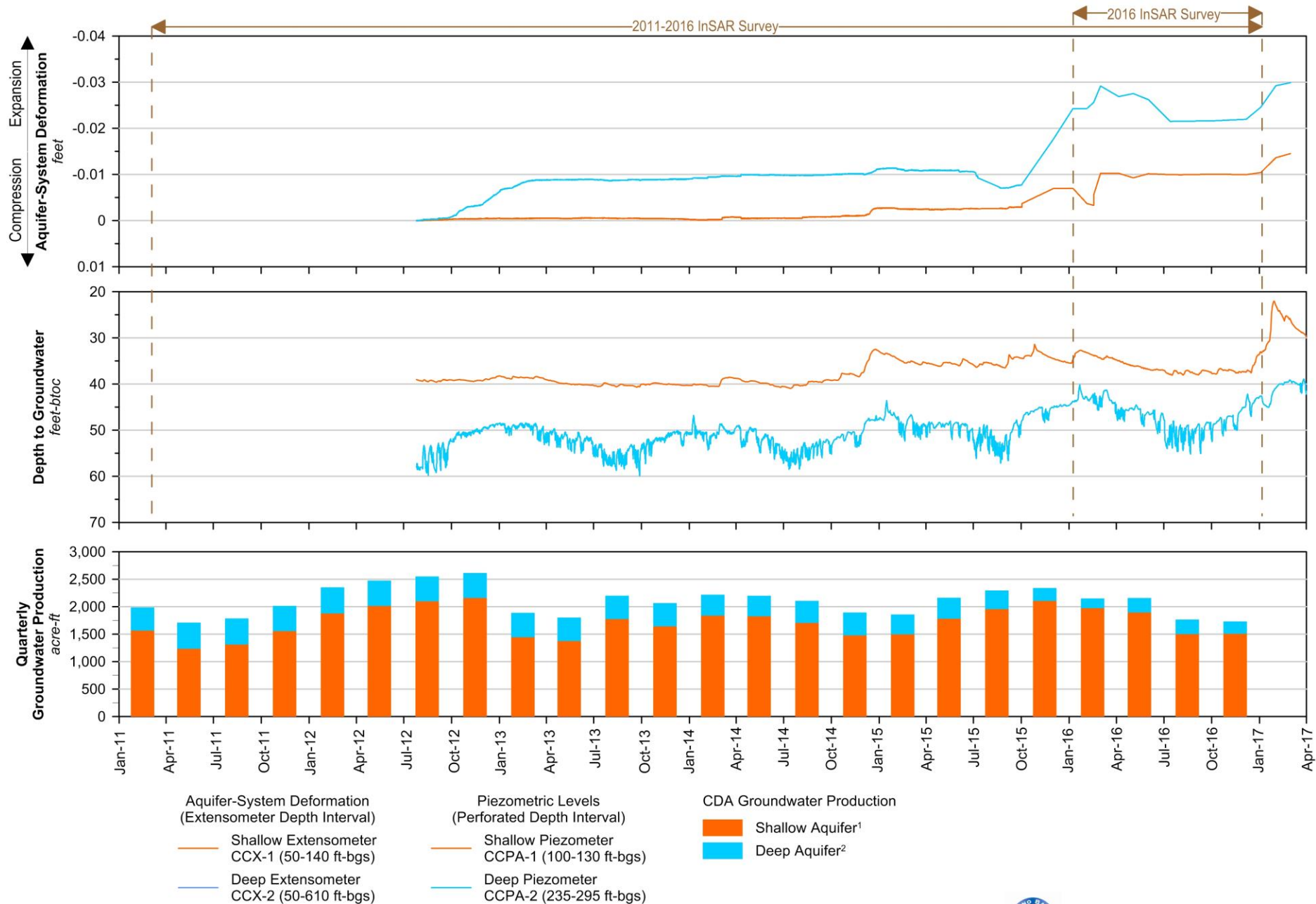
- ▶ Ground-level surveys and the CCX data indicate very little, if any, ongoing subsidence in the Southeast Area even though groundwater production at the Chino Creek Well Field began in the second quarter of 2014 and increased through 2016.
- ▶ The InSAR and ground-level survey datasets do not always corroborate each other in the pattern and/or magnitude of vertical ground motion in the Southeast Area where both datasets overlap—likely due to InSAR incoherence associated with the agricultural land uses in this area.
 - Ground-level surveys should continue to be the primary method of measurement of vertical ground motion across the Southeast Area.
 - An elevation survey at the existing benchmark monuments in the Southeast Area should be performed during winter/spring 2018 because two additional Chino Creek Desalter wells (I-20 and I-21) commenced production in February 2016.

Vertical Ground Motion in the Southeast Area 2011-2016



Vertical Ground Motion in the Southeast Area 2016





History of Land Subsidence in the Southeast Area

Piezometric Levels at Wells (Top-Bottom of Screen Interval)

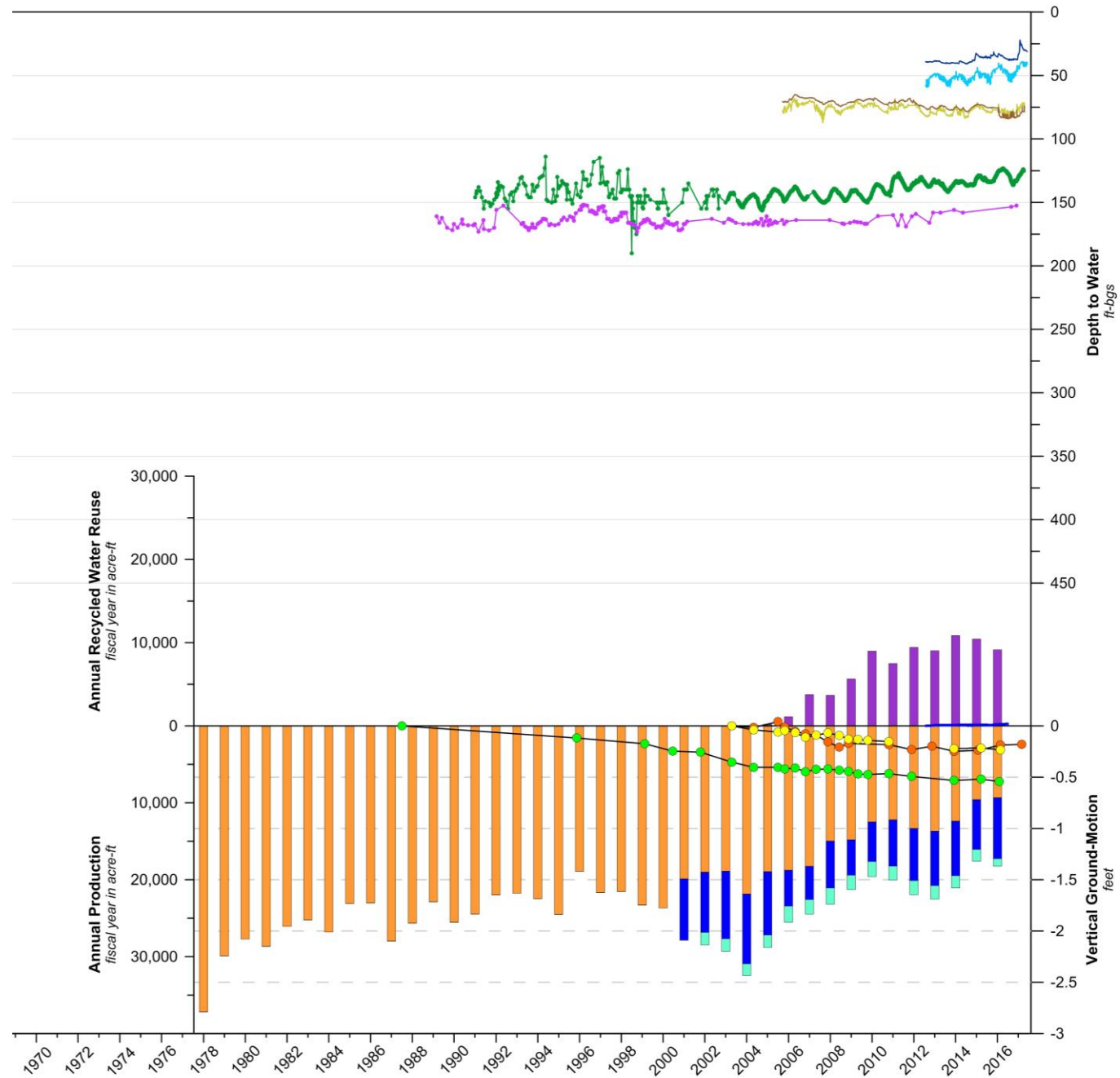
- C-13 (290-720 ft-bgs)
- CH-18A (420-980 ft-bgs)
- HCMP-1/1 (135-175 ft-bgs)
- HCMP-1/2 (300-320 ft-bgs)
- CCPA-1 1230583
- CCPA-2 1230584

Vertical Ground-Motion (Cumulative Displacement)

- BM 133/61
- BM 137/61
- BM 157/71
- CCX-2 Extensometer Measures between: 50 and 610 ft-bgs

Recharge and Production

- Recycled Water Reuse Applied in the Southeast Area
- Groundwater Production from Municipal and Private Wells in the Southeast Area
- Groundwater Production from Desalter Wells in the Upper Aquifer
- Groundwater Production from Desalter Wells in the Lower Aquifer



Conclusions and Recommendations:

Northwest MZ-1 Area

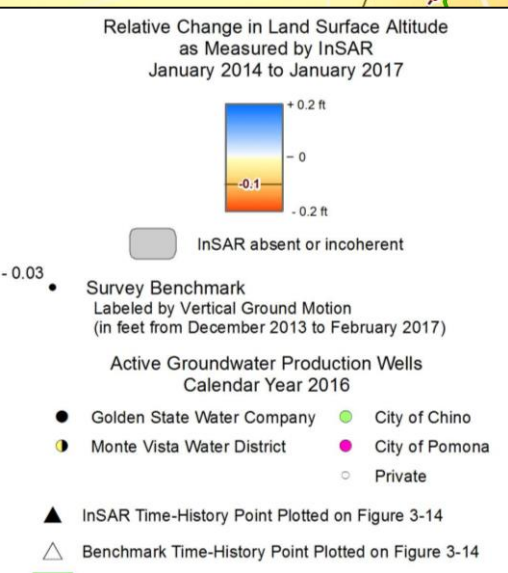
- ▶ Concentrated differential land subsidence continued to occur in Northwest MZ-1 across the San Jose Fault
 - Continue monitoring vertical and horizontal ground-motion via InSAR and elevation/EDM surveys at benchmarks.
 - Continue implementation of the *Work Plan to Develop a Subsidence-Management Plan for the Northwest MZ-1 Area*
 - Investigations into the cause(s) of the observed land subsidence → Pomona Extensometer and high-resolution monitoring of production, recharge, and piezometric levels
 - Development and evaluation of subsidence-management alternatives to minimize or abate future subsidence

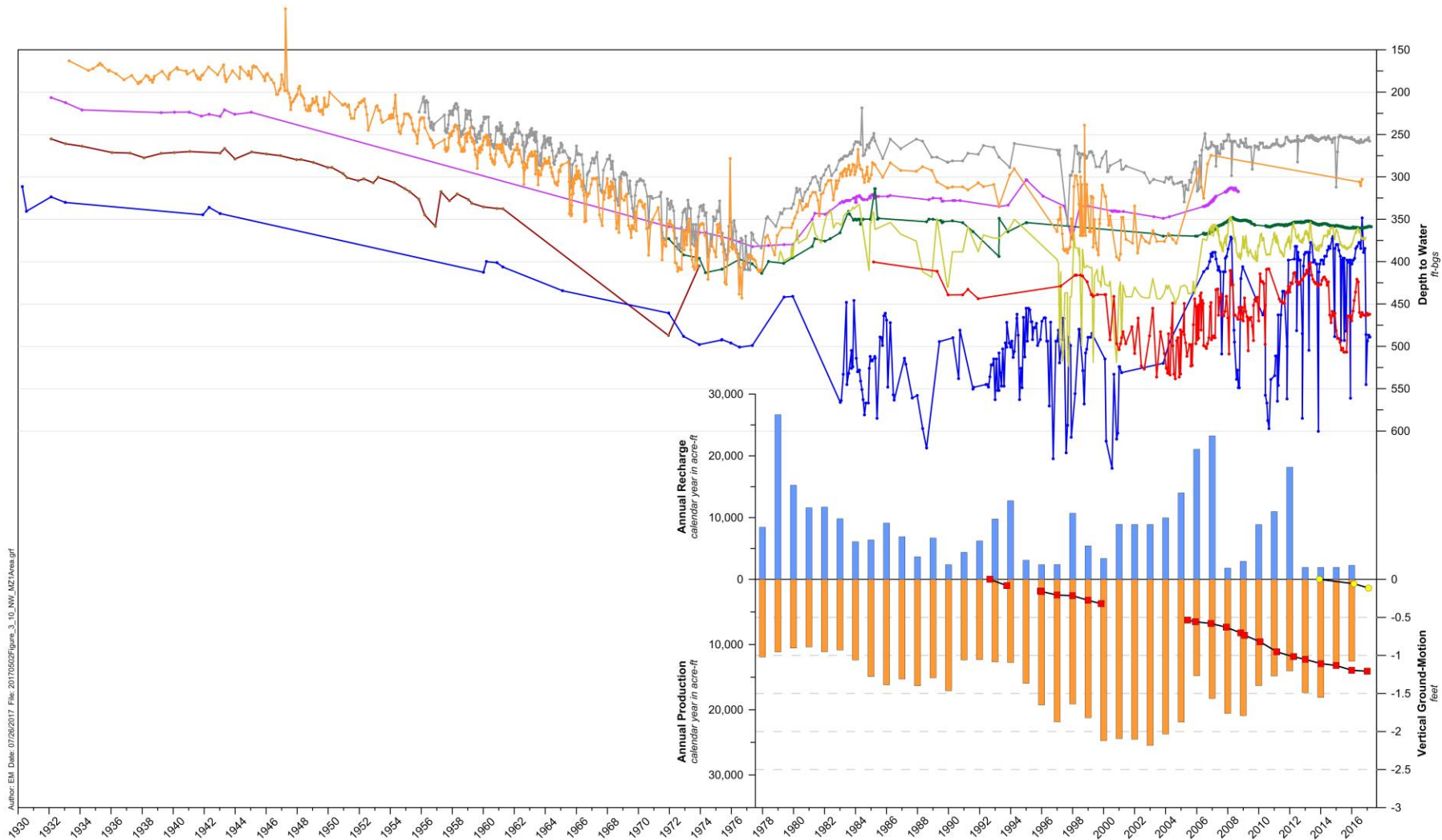
Vertical Ground Motion in the Northwest MZ1 Area (2014-2016)

Relative Change in Land Surface Altitude as Measured by InSAR January 2014 to January 2017

Legend:

- Relative Change in Land Surface Altitude as Measured by InSAR January 2014 to January 2017: -0.2 ft to +0.2 ft
- InSAR absent or incoherent
- Survey Benchmark: Labeled by Vertical Ground Motion (in feet from December 2013 to February 2017)
- Active Groundwater Production Wells Calendar Year 2016:
 - Golden State Water Company
 - Monte Vista Water District
 - Private
 - City of Chino
 - City of Pomona
- InSAR Time-History Point Plotted on Figure 3-14
- Benchmark Time-History Point Plotted on Figure 3-14





Prepared by:



Piezometric Levels at Wells (Top-Bottom of Screen Interval)

- MV-1 (245-472 ft-bgs)
- MV-08 (225-447 ft-bgs)
- MV-10 (520-1,084 ft-bgs)
- MV-13 (203-475 ft-bgs)
- P-05(OLD) (141-488 ft-bgs)
- P-18 (307-660 ft-bgs)
- P-27 (472-849 ft-bgs)
- P-30 (565-875 ft-bgs)

Vertical Ground-Motion (Cumulative Displacement)

- InSAR Point C (see Figure 3-1a)
- BM B-403

Recharge and Production

Recharge of Recycled Water, Storm-water,* and Imported Water at the College Heights, Upland, Montclair, and Brooks Recharge Basins; and, at MVWD ASR Wells

*Storm-water is an estimated amount prior to fiscal year 2004/05

Groundwater Production from Wells in Central MZ1 Area



Ground-Level Monitoring Committee
2016 Annual Report

The History of Land Subsidence in the Northwest MZ1 Area

*See Figures 3-1a, b for locations of wells, benchmarks, and extensometers

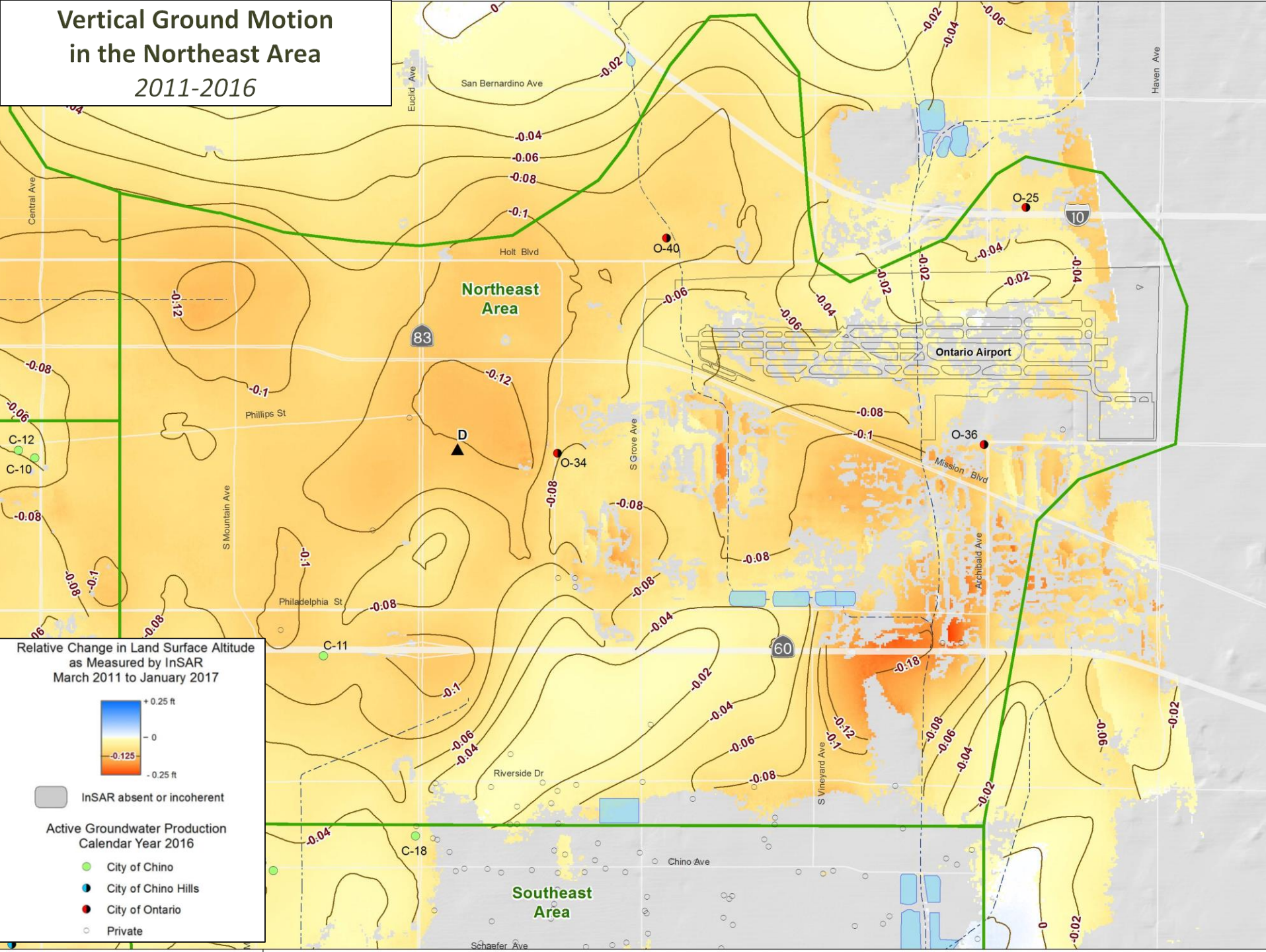
Figure 3-14

Conclusions and Recommendations:

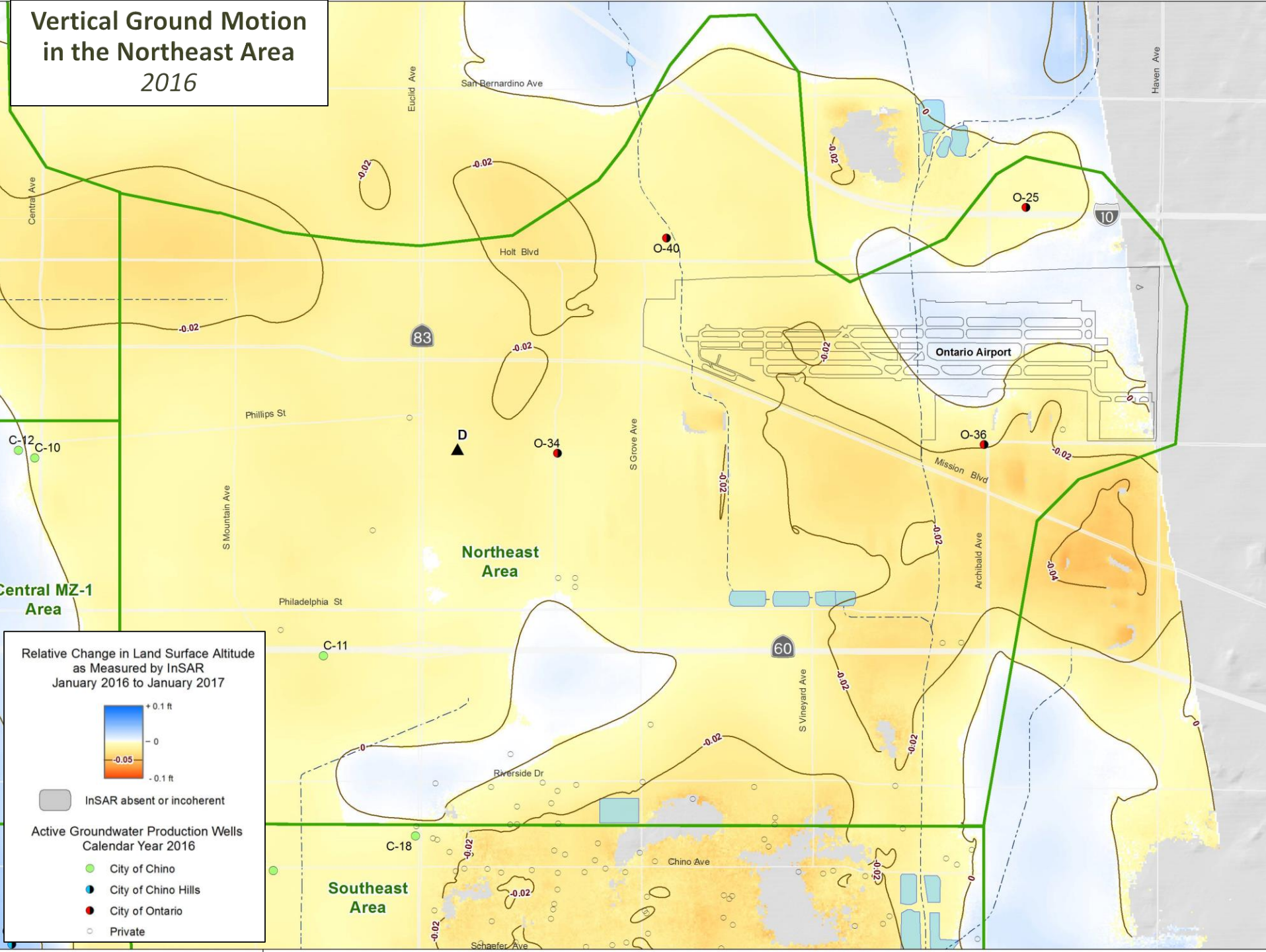
Northeast Area

- ▶ About one-foot of gradual and persistent land subsidence has occurred in the Northeast Area since 1992 and appears to be ongoing.
- ▶ InSAR data are largely incoherent in some areas that are experiencing subsidence, such as south and southwest of the Ontario Airport.
 - Establish an array of benchmark monuments across the subsiding portions of the Northeast Area and perform elevation surveys

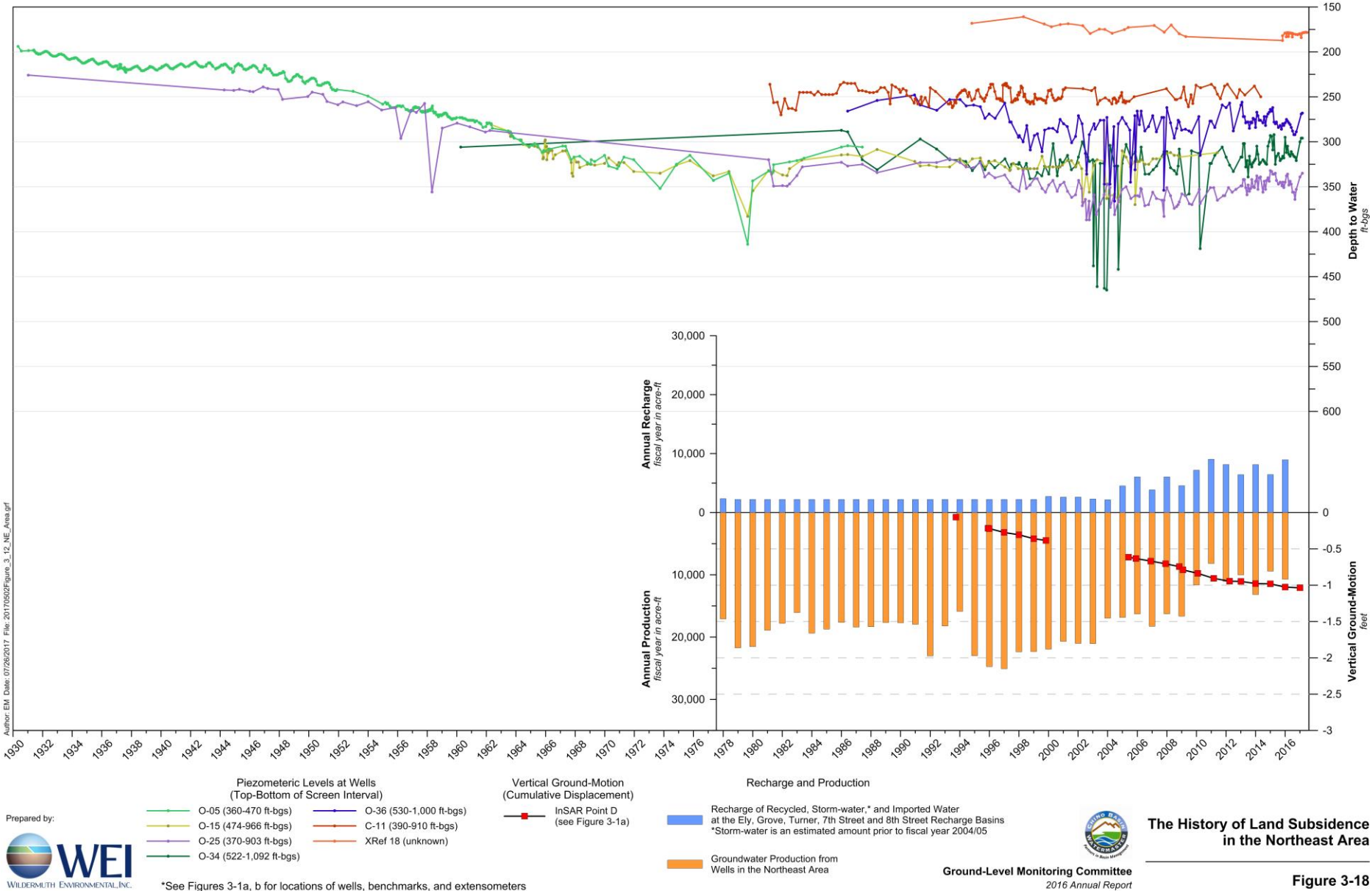
2011-2016



2016



Author: EM Date: 07/26/2017 File: 20170502Figure_3_12_NE_Area.grf



*See Figures 3-1a, b for locations of wells, benchmarks, and extensometers

Conclusions and Recommendations:

Horizontal Monitoring

- ▶ EDMs appear to record elastic and inelastic horizontal strain that is contemporaneous with elastic and inelastic vertical ground motion in the Managed Area
 - EDMs between closely-spaced benchmark monuments appear to be a suitable monitoring technique to detect the occurrence of tensile strain within shallow soils and the potential threat of ground fissuring.
 - The Fissure Zone in the Managed Area and the San Jose Fault Zone in Northwest MZ-1 should be monitored by EDMs in the future.
 - As long as permanent subsidence is absent in the Managed Area, EDM surveys across the Fissure Zone should be performed at a frequency longer than annual, and in conjunction with elevation surveys at monuments across the Managed Area at times of full recovery (or near full recovery).
 - A new horizontal extensometer across the Fissure Zone is not recommended at this time, because:
 - EDM surveys are a suitable technique to monitor for the occurrence and magnitude of inelastic tensile strain in shallow soils across the Fissure Zone
 - Currently very little, if any, permanent land subsidence in the Managed Area and tensile strain across the Fissure Zone is occurring
 - Very little, if any, permanent land subsidence in the Managed Area and tensile strain across the Fissure Zone is expected to occur as a result of the Long-Term Pumping Test
 - Very little, if any, additional management-grade information would be provided by a horizontal extensometer (that would not be provided by EDMs), and therefore the cost is not justified.

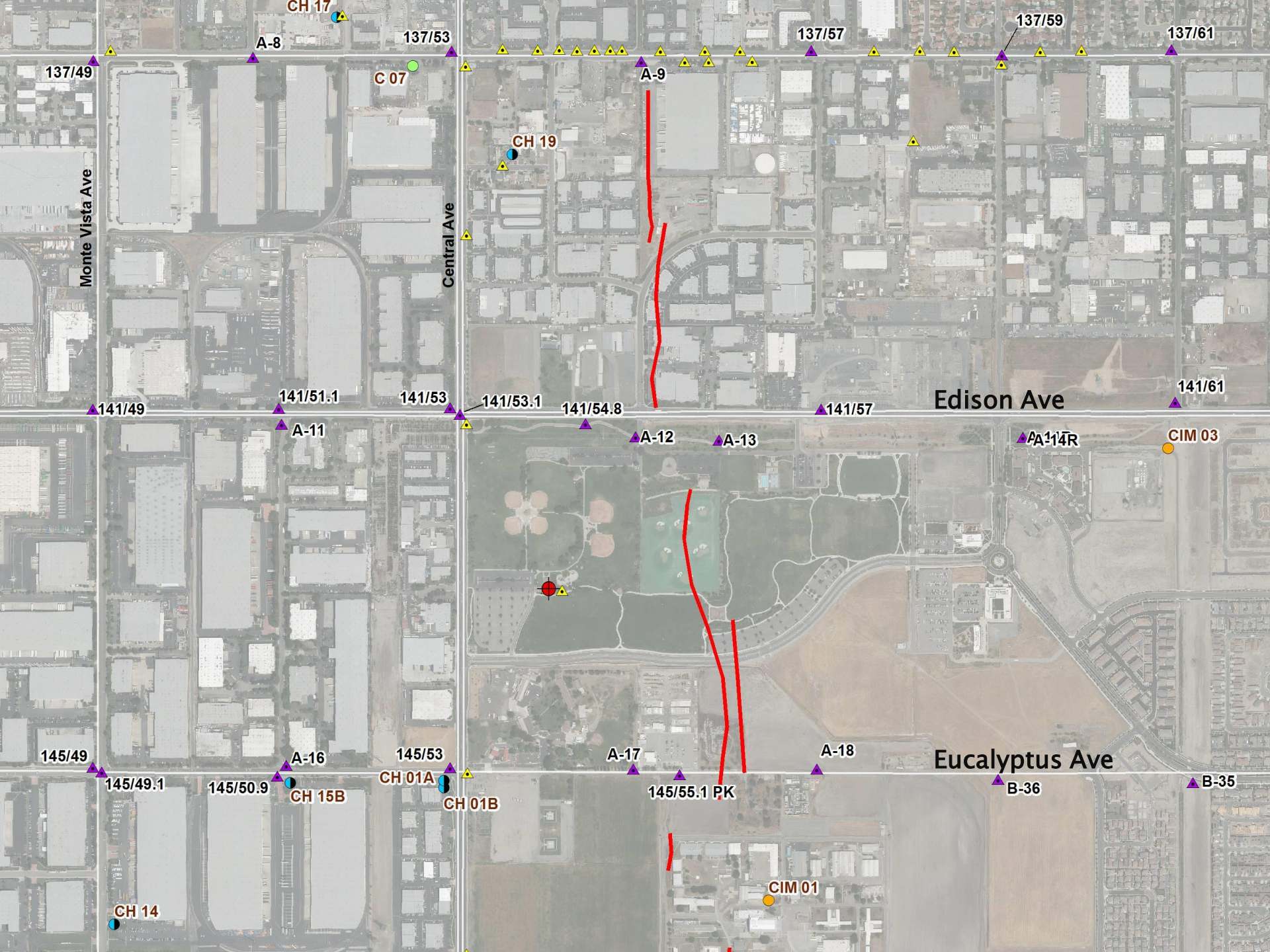
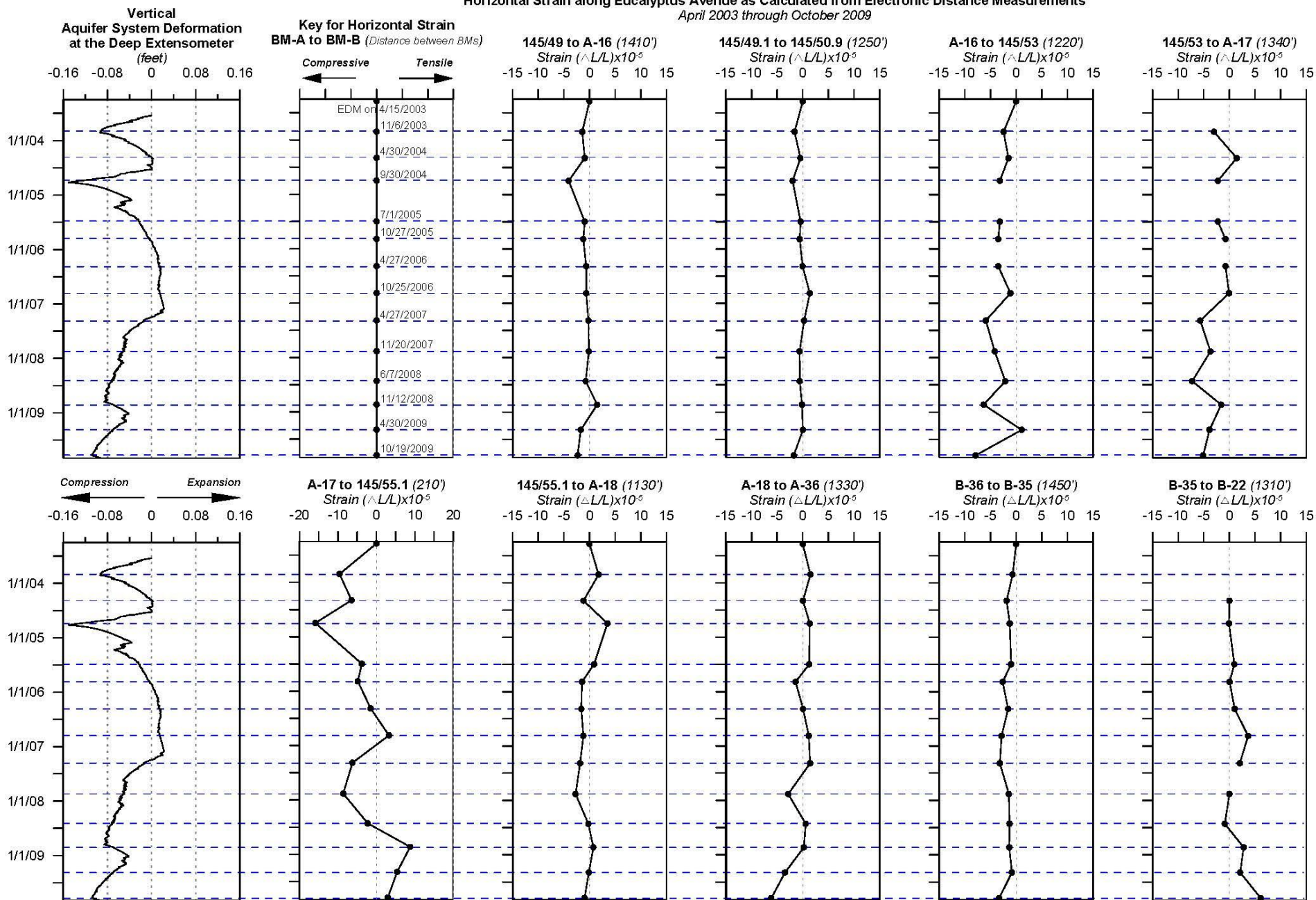


Figure 3-6b
Horizontal Strain along Eucalyptus Avenue as Calculated from Electronic Distance Measurements
April 2003 through October 2009



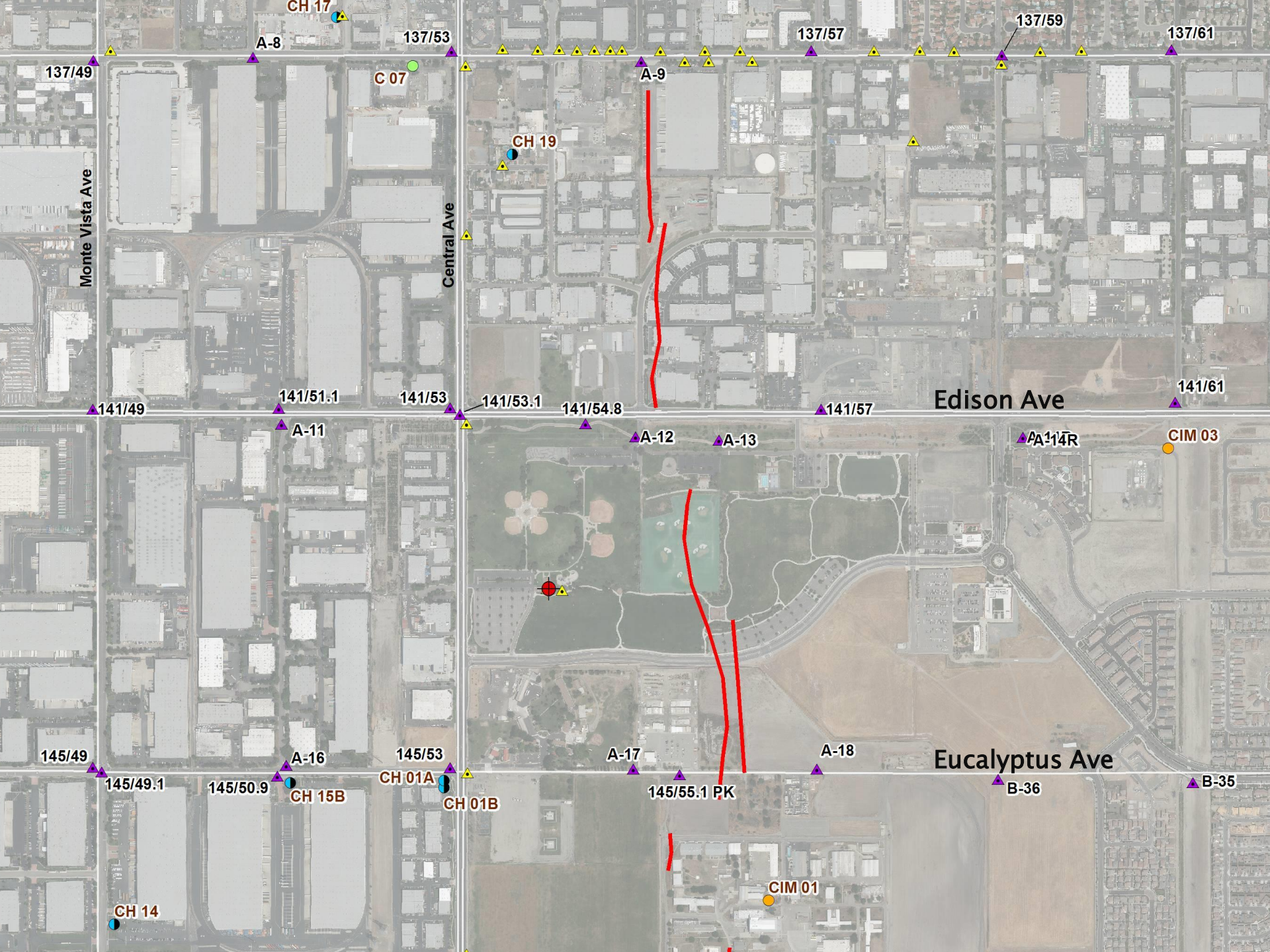
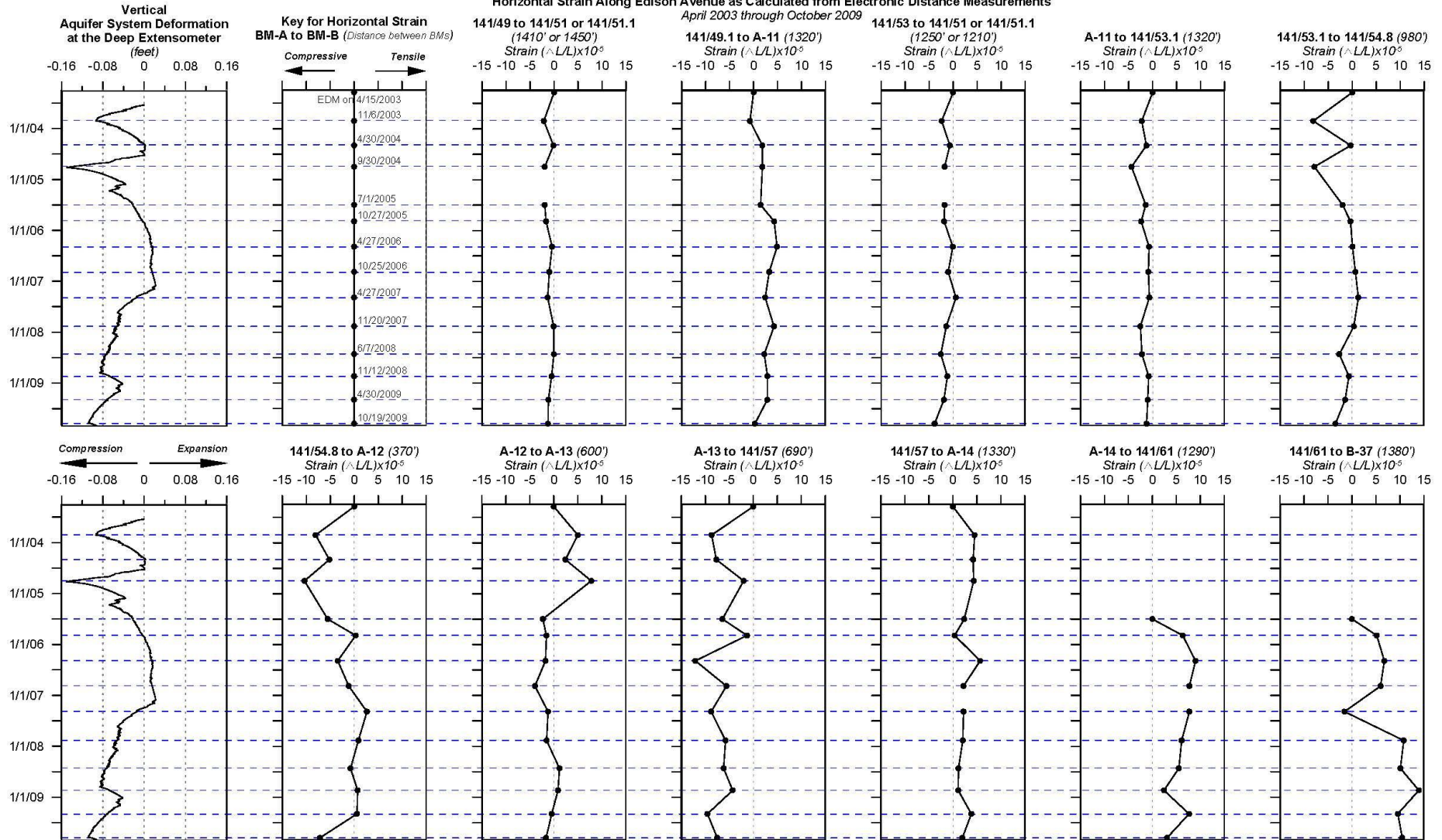


Figure 3-6c

Horizontal Strain Along Edison Avenue as Calculated from Electronic Distance Measurements

April 2003 through October 2009



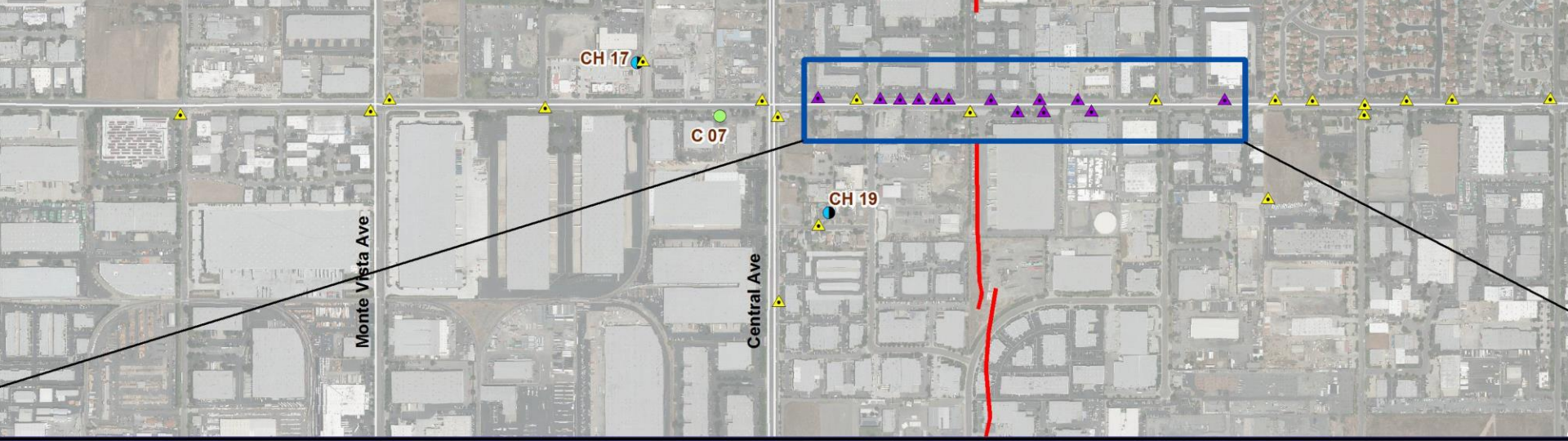
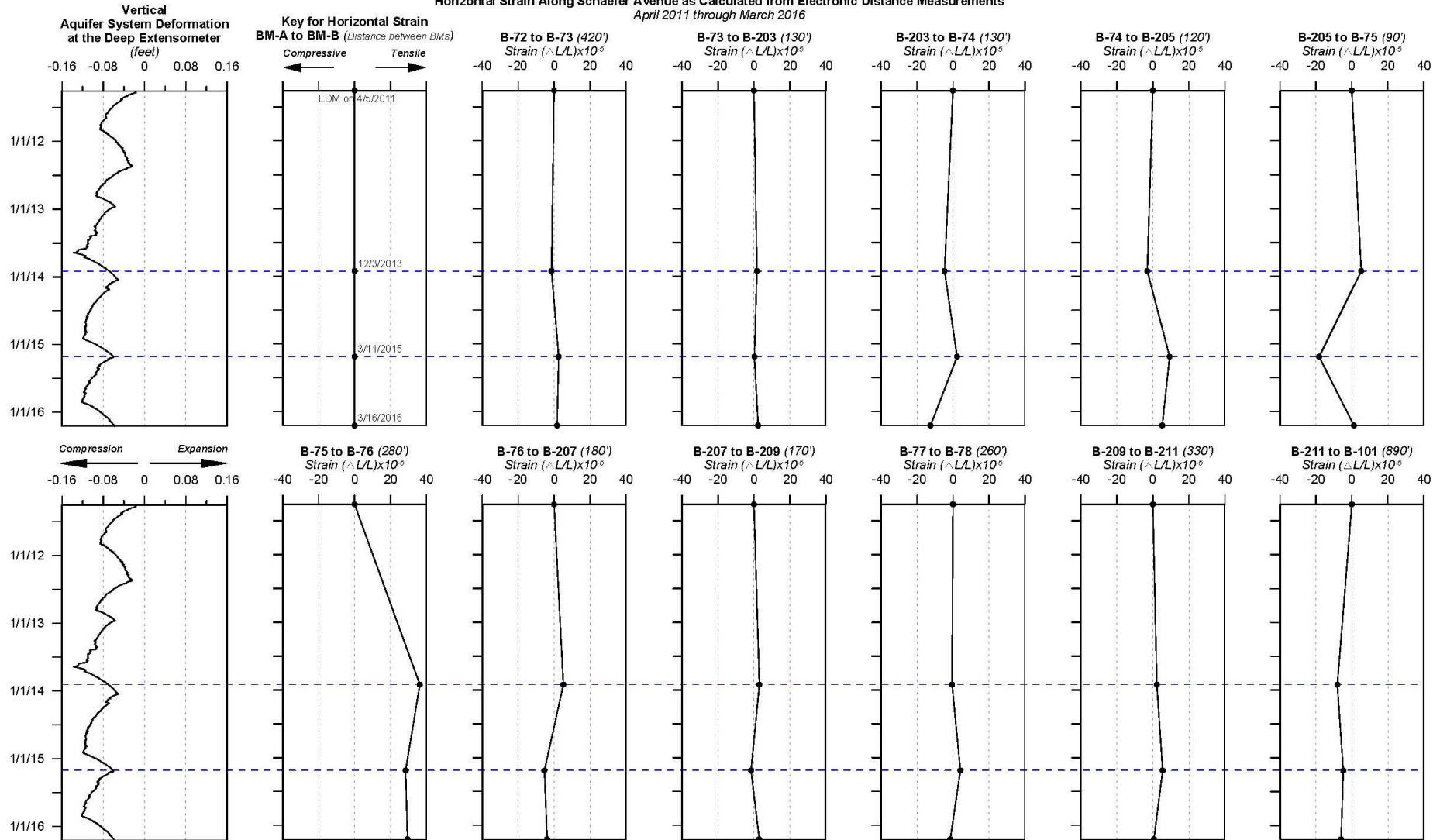


Figure 3-7b

Horizontal Strain Along Schaefer Avenue as Calculated from Electronic Distance Measurements
April 2011 through March 2016



Fig_6_Schaefer_11-16.grf
Printed on 4/6/2017



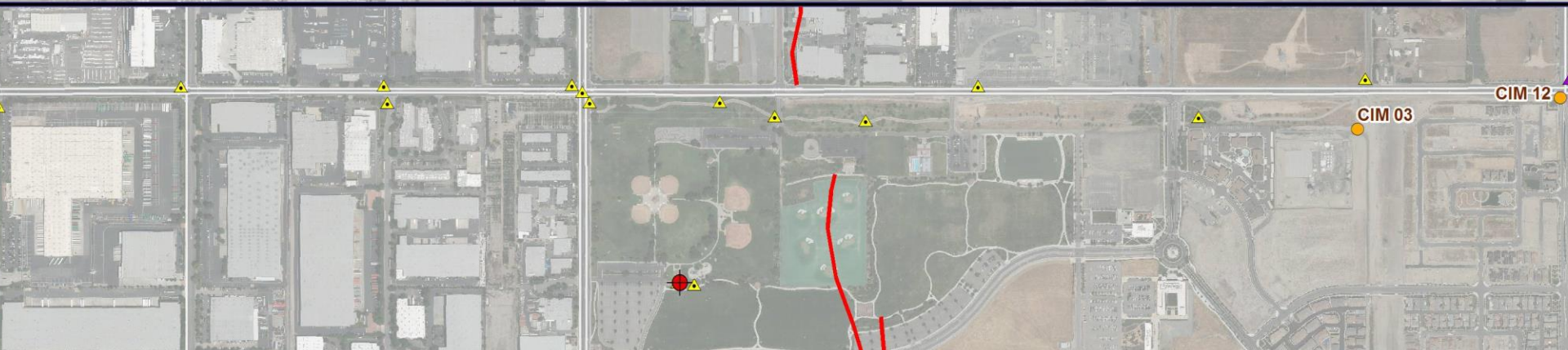
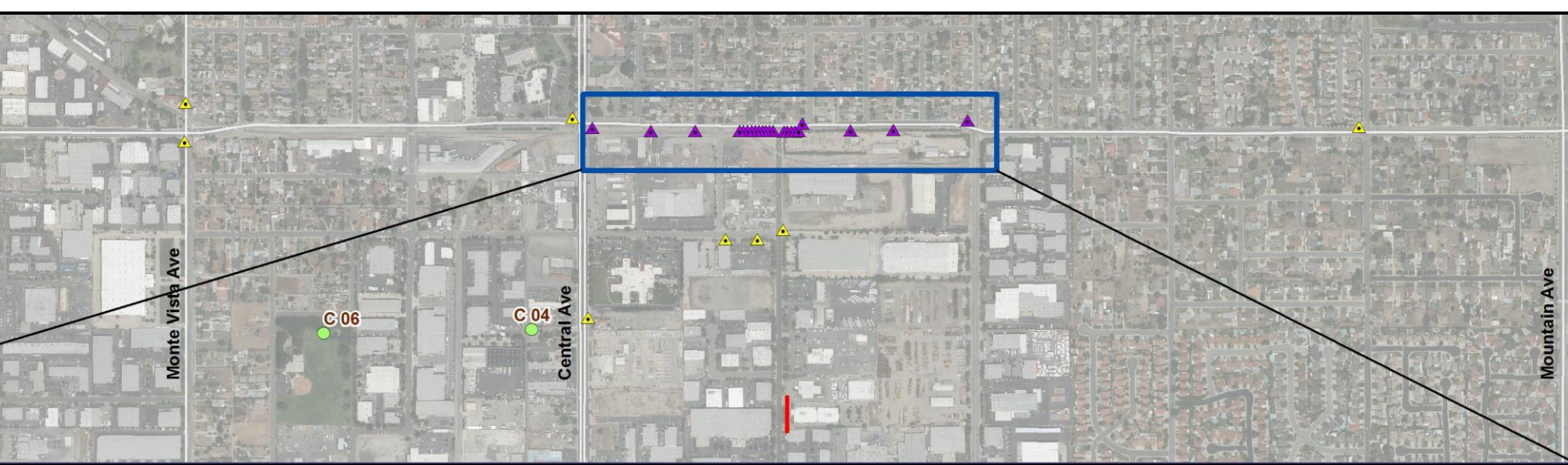
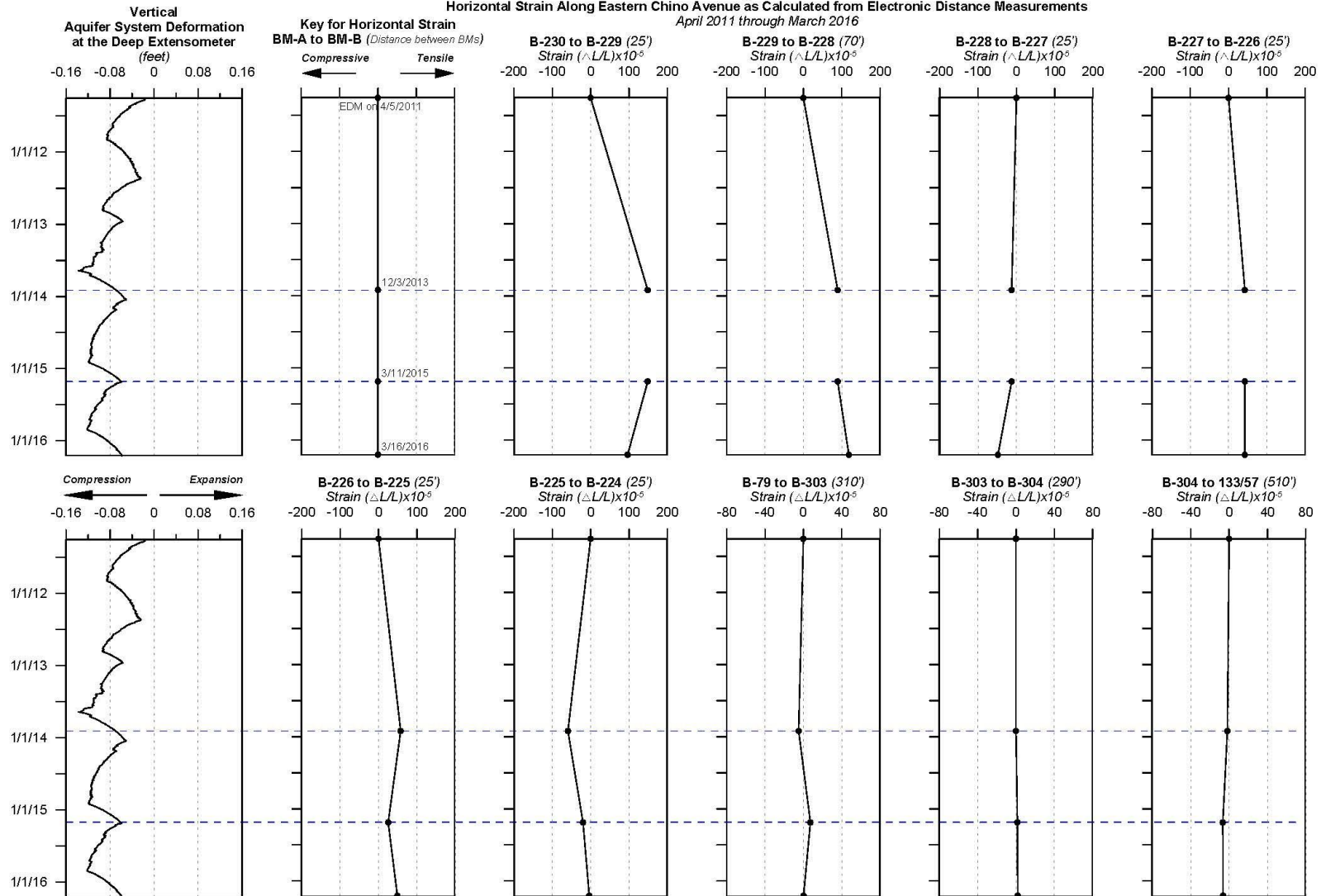
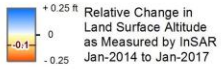
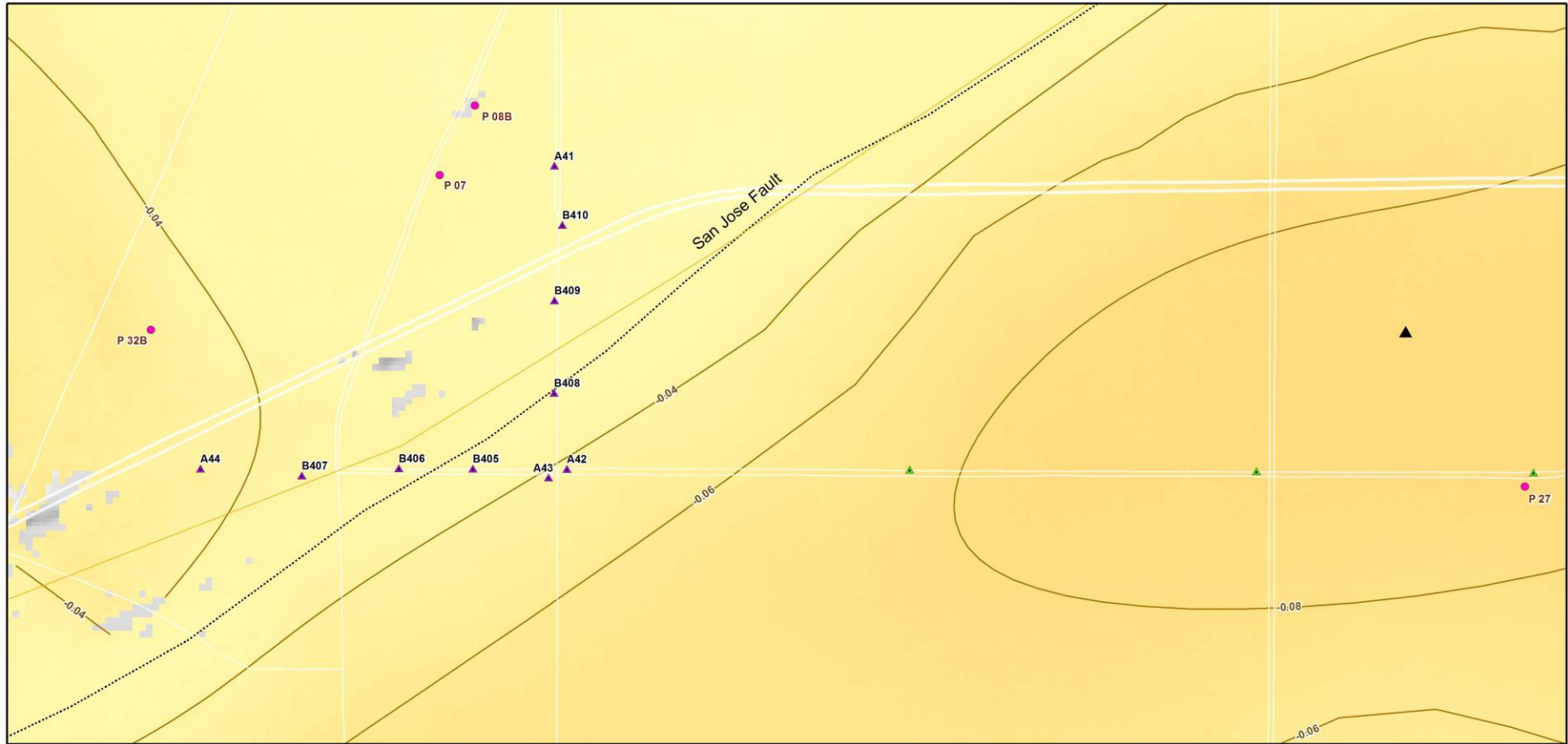


Figure 3-8c
Horizontal Strain Along Eastern Chino Avenue as Calculated from Electronic Distance Measurements
April 2011 through March 2016



Fig_4b_Chino_11-16_p1.grf
Printed on 4/6/2017





InSAR data incoherent

Survey Benchmarks

- ▲ Existing Benchmark Monument
- ▲ Existing Benchmark Monument with Survey Data shown in Figure 3-17

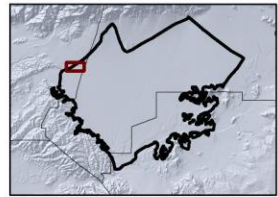
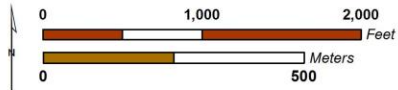
- ▲ InSAR Time-History Point Plotted on Figure 3-17

- Active Production Wells by Owner
- City of Pomona

Prepared by:



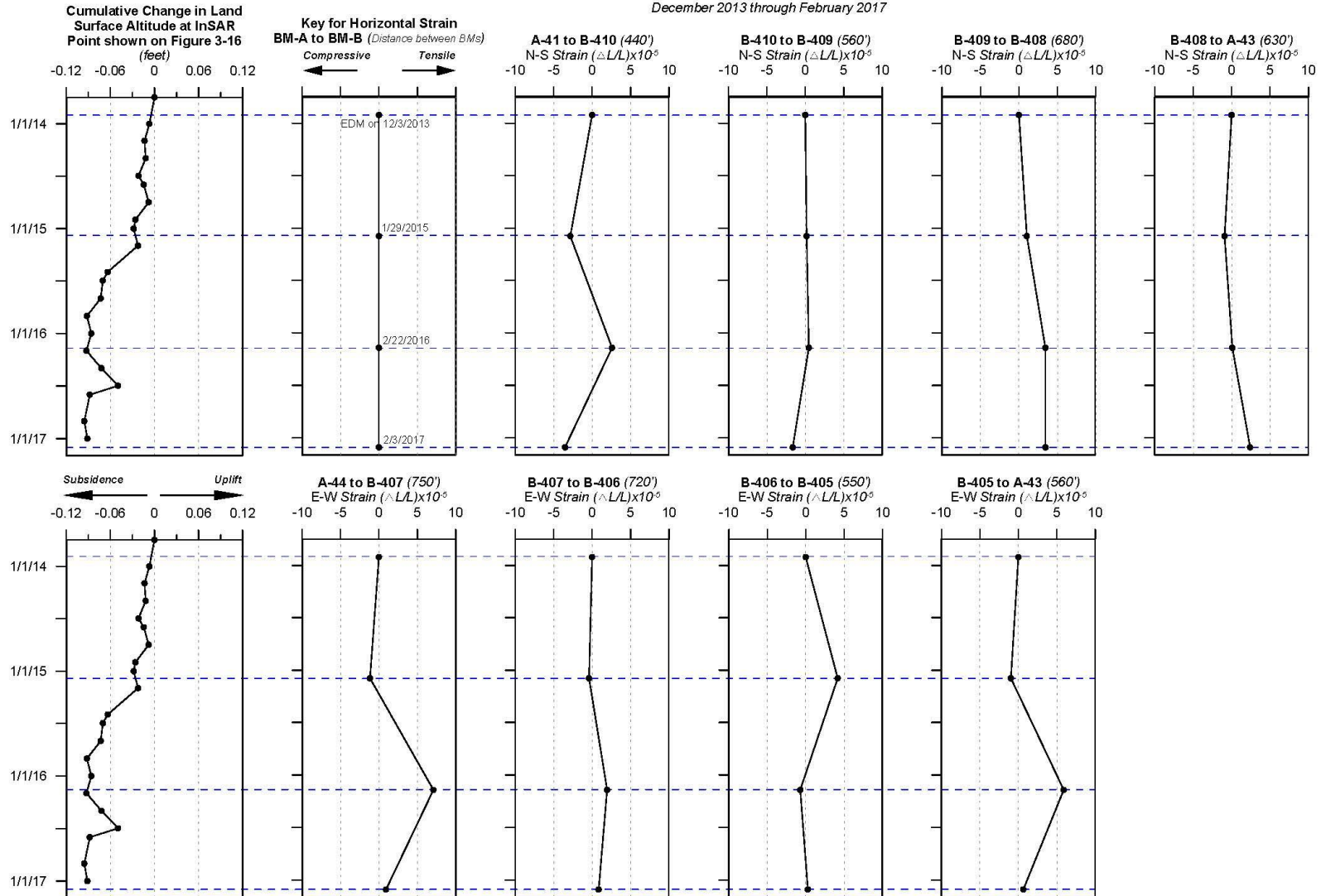
Author: GAR
Date: 20170712
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**Benchmark Monuments
Across the San Jose Fault**

Figure 3-16

Figure 3-17
Horizontal Strain Across the San Jose Fault as Calculated from Electronic Distance Measurements
December 2013 through February 2017



Fig_4a_Chino_10-16_p1.grf
Printed on 4/6/2017



GLMC Next Steps

▶ August 24, 2017

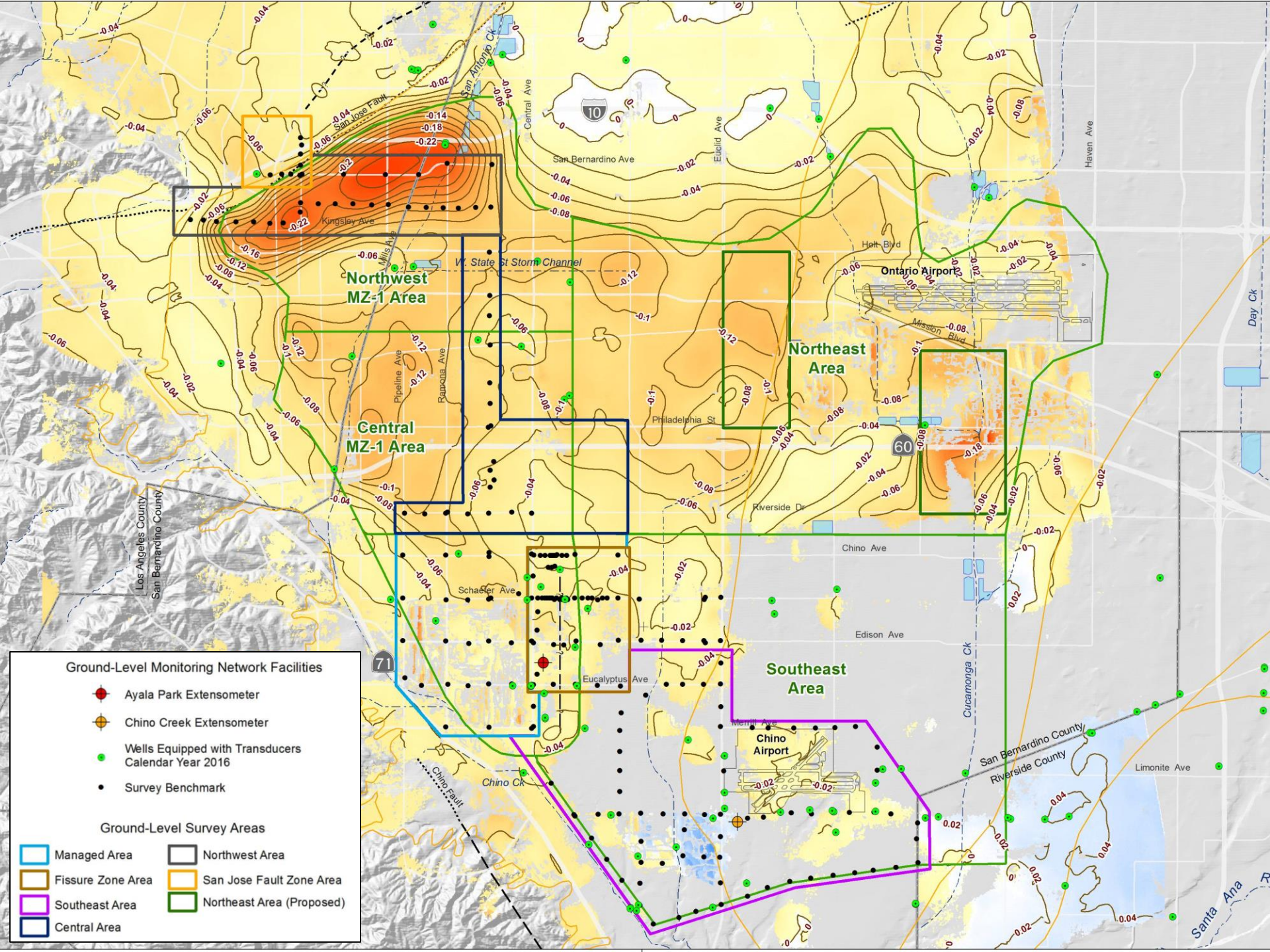
- Committee submits comments and suggested revisions on the draft annual report

▶ September 7, 2017

- Final annual report is included in the agenda packet for the September Watermaster meetings for receive and file

▶ September 28, 2017

- Committee meeting – Planning and Implementation



Pomona Extensometer Facility

Scope and Schedule

Task	Schedule
Siting Study	Completed
Draft Technical Specifications	Completed
Finalize CEQA	August 2017
Acquire Construction and Permanent Easements	August 2017
Prepare Bid Package and Conduct Bidding Process	August/September 2017
Drilling and Well Construction	October – December 2017
Monitoring Equipment Installation	January – February 2018
Begin PX Monitoring	March 2018