Case Study: VC2

Vertebrae AS/SVE Under Highway

SITE
Active Fueling Station and Farm Store, Greeley Colorado

CONTAMINATION
Diesel and Gasoline range organics including LNAPL. The LNAPL plume is approximately 20,000 square feet. The dissolved-phase plume, above RBSLs, is approximately 40,000 square feet.

OBJECTIVE
The design involved 5 Vertebrae™ well systems to provide targeted air sparging (AS) utilizing 29 independent well segments and 5 Vertebrae™ well systems to provide soil vapor extraction (SVE) utilizing 19 independent well segments. The individual well systems varied in length from 466 to 616 feet.

This case study illustrates how Vertebrae™ can be installed under a host of obstacles with little to no business disruption.

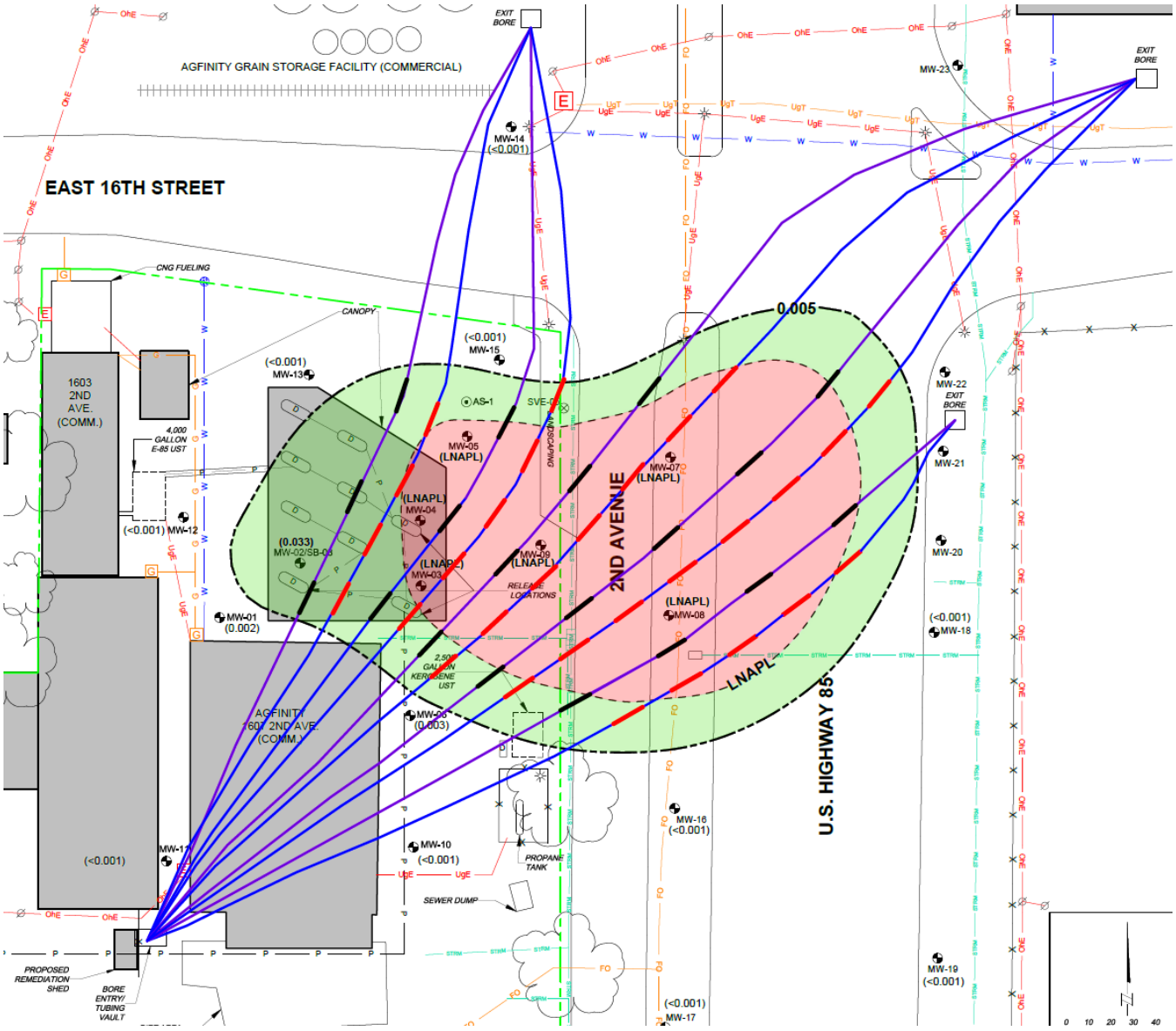
BACKGROUND
A release was reported in August 2016, when a diesel line leak detector began to alarm. Subsequent environmental assessment results identified gasoline range organics (GRO) in soil and groundwater extending from the dispenser island area. The source of the GRO is unknown and is suspected to be historic. The fueling system has been in service since 1983.

INSTALLATION ACTIVITIES
The installation of the 10 Vertebrae at the site involved over 5,200 feet of Horizontal Direction Drilling (HDD) and was completed in four weeks. Installation went under, US Highway 85, 2nd Avenue, dispensers, the canopy, parking areas, and piping went under the building and under old USTs to deliver a balanced network, otherwise impossible. This was completed while maintaining full operational status of fueling and store operations; the roadways, and adjacent properties remained fully operational (although the auto repair shop did require patrons to drive around the drill rig to get into their first repair bay).

SYSTEM OPERATION RESULTS
The system became fully operational in March 2018. The total SVE flow is regulated at 400 cfm. All 19 Vertebrae SVE segments run continuously averaging 1.4 cfm per linear foot of screen. The 29 Vertebrae AS segments are cycled on an 8-hour basis running between 6 and 9 segments at a time, averaging 60 to 90 total cfm.

LAYOUT FIGURE

The below figure illustrates how the AS (red) and SVE (black) wells are installed without consideration to typical obstacles.



CONCLUSIONS

Vertebrae™ is an excellent tool to deliver remedial treatments under buildings and other above and below ground infrastructure. Cost effectively, it can be constructed with higher density to provide complete plume coverage. The horizontal nature of the Vertebrae™ well system allowed AS/SVE wells to be installed under HWY 85 and 2nd Avenue which could not have been accomplished with a vertical well AS/SVE remediation system. The Vertebrae™ well system allows for enhanced control since each well segment is independently plumbed to land surface.

The Impressive Benefits

- Access areas previously considered inaccessible
- Zero business disruption
- No obstacles to stand in its way

As more sites utilize Vertebrae™ for remediation, especially in hard to reach places, we expect users to appreciate the benefits and chose Vertebrae™ as the preferred "tool" to implement the selected remedial approach.

VERTEBRAE™ WELL SYSTEMS
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PERFORMANCE MONITORING RESULTS

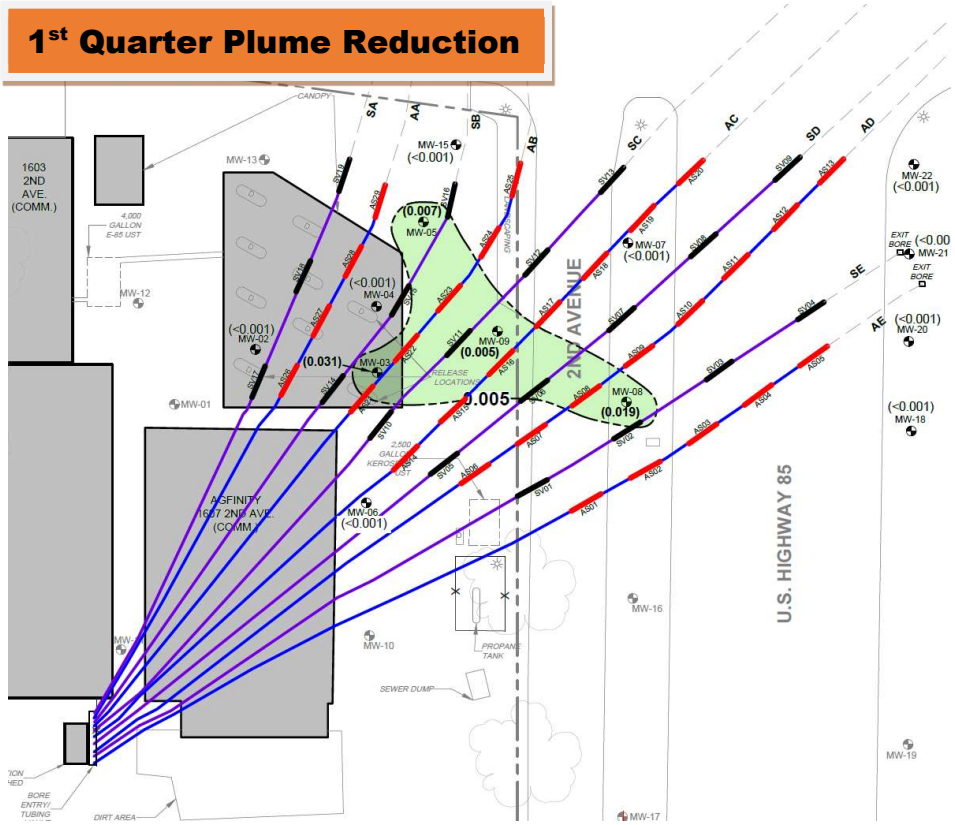
The first post quarterly sampling results displayed dramatic reduction in plume size with only four wells above RBSLs, MW-3, MW-5, MW-6, and MW-9 (figure right). The areal extent of the plume was reduced by approximately 70% in size and more significantly an estimated 95% mass reduction.

The second post quarterly sampling results displayed one well above RBSLs (not shown).

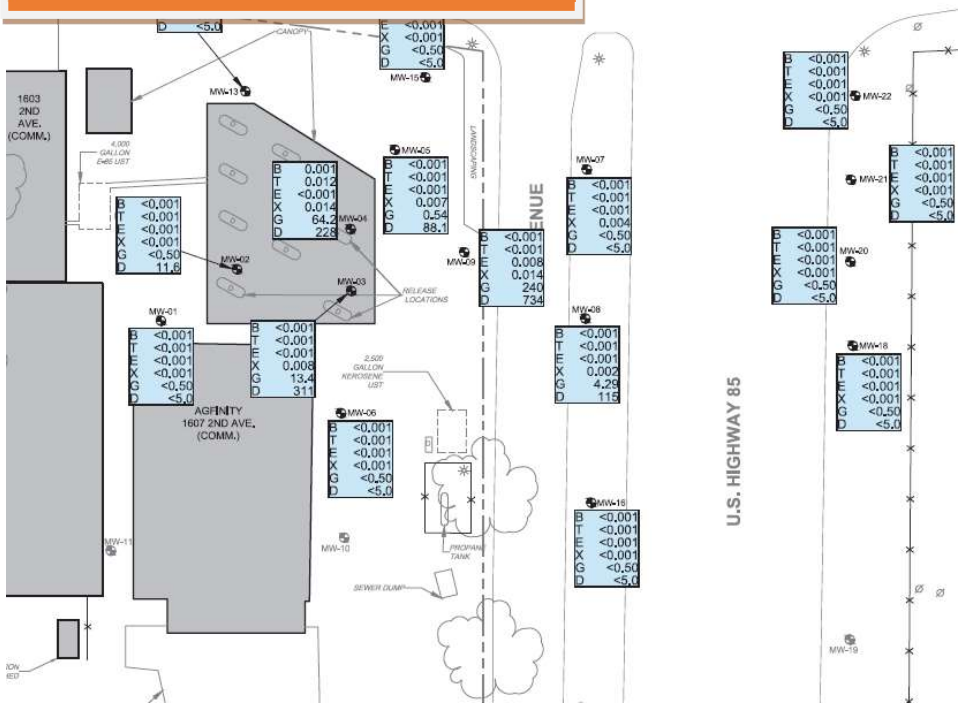
The second quarter data was analyzed, and adjustments were made to improve the performance and maximize the efficiency of the remedial system. The Vertebrae™ well system allows for adaptation in order to continue the proper treatment. Air sparging and soil vapor extraction was intensified in the source area utilizing independent well segments to focus on the recalcitrant area around MW-3.

Finally, but in unprecedented speed, the third post quarterly sampling results revealed no wells above RBSLs (figure right).

1st Quarter Plume Reduction



3rd Quarter Plume Missing



CONCLUSIONS

Vertebrae™ is an excellent tool to deliver remedial treatments under buildings and other above and below ground infrastructure. Cost effectively, it can be constructed with higher density to provide complete **adjustable** plume coverage. The Vertebrae™ well system not only provides more contact with the plume but also provides enhanced control since with customized individual well segments. In three quarters all well sampling results are below RBSLs and on track for site closure.

As more sites utilize Vertebrae™ for remediation, and experience the added control and improved efficiency, more sites will choose Vertebrae™ as the preferred "tool" to implement the selected remedial approach.

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