

# Alaskan Way Viaduct **REPLACEMENT** PROGRAM



June 2014

## Protecting structures along the SR 99 tunnel route

The SR 99 Tunnel Project is one of the largest excavation projects in the history of our state.

The project's five-story-tall tunneling machine will remove approximately one million cubic yards of soil by the time it finishes digging the tunnel. While the ground naturally experiences movement over time, digging underground may cause additional movement.

We researched the soil's characteristics before establishing the two-mile-long tunnel route. Most of the tunneling will take place deep beneath downtown Seattle in terrain that is very dense and stable. In fact, multiple tunnels in the region have been successfully excavated in similar conditions. Soils along the tunnel route that are prone to settlement will be strengthened before the machine digs through them.

### Settlement monitoring program

While we do not anticipate significant levels of settlement, as a precaution, we are implementing a comprehensive program to monitor and mitigate any effects of tunneling. As the tunneling machine pushes forward through the earth, crews are measuring the soil it removes while also tracking any ground movement or changes above its path.

Buildings, utilities and streets located above and near the tunnel route will be monitored before, during and after construction. Each building was surveyed prior to construction to document its interior and exterior condition. Monitors installed on buildings by our crews are being checked against data from before construction, as well as data from

monitors installed outside the monitoring area.

If damage does occur to buildings, utilities or streets as a result of tunnel construction, WSDOT will be responsible for repairs. We will rely heavily on pre-construction surveys and monitoring data to evaluate construction-related damages.



*Assembly of the SR 99 tunneling machine in the launch pit west of Seattle's stadiums.*

### June 2014 update: Repairing the SR 99 tunneling machine

In December 2013, Seattle Tunnel Partners, the contracting team hired by WSDOT to design and build the SR 99 tunnel, stopped tunneling approximately 1,000 feet into the tunnel drive after measuring increased temperatures in the tunneling machine. While investigating the cause of the high temperatures, STP discovered damage to the machine's seal system and contamination within the main bearing. STP is working to repair the seal system and replace the main bearing so that crews can resume tunneling by the end of March 2015.

STP released an updated construction schedule in April 2014 that delays tunneling by up to 16 months. However, STP is working to recover as much as five months of schedule in order to open the tunnel in November 2016, WSDOT's original opening date as stated in the project's request for proposals. Per the SR 99 tunnel contract, STP agreed to open the tunnel in late 2015, 11 months earlier than WSDOT's requirement. The responsibility for additional costs and delays associated with this work will be addressed in accordance with the contract.

For the latest information about STP's work to resume tunneling, visit: [www.wsdot.wa.gov/Projects/Viaduct/About/FollowBertha](http://www.wsdot.wa.gov/Projects/Viaduct/About/FollowBertha).

# Monitoring Equipment



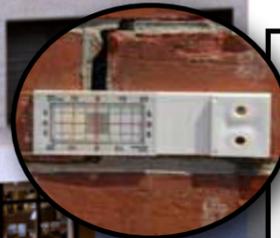
## Monitoring points

- Size: Ranges from 6-by-6-inch prism to as small as a nail head.
- Continuously read by automated survey machines mounted on each block, or by manned survey equipment.
- Several monitoring points will be installed on building exteriors.



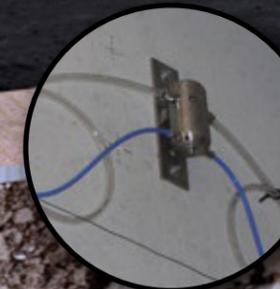
## Ground monitoring instruments

- Size: 4 to 12 inches in diameter.
- Installed 2 to 300 feet underground in public right of way (streets and sidewalks) and covered with caps that resemble small manhole covers.
- Measures movement deep underground.
- Most electronically transmit data to project team; however, some require manual readings.



## Crack gauge

- Size: Approximately 1 inch by 6 inches.
- Attaches to building with epoxy.
- Measures existing building cracks and any changes.



## Liquid level sensor

- Size: A half-inch diameter tube filled with water that feeds into a 6-by-3-inch device that measures water level.
- Mounts on an interior wall, usually in basements, with bolts and brackets.
- Electronically transmits data to project team.



## Automated survey machine

- Size: Approximately 1 foot by 6 inches, plus brackets or stand.
- Attaches to building roof or exterior.
- Continuously scans monitoring points to detect movement. Immediately transmits data to project team. Operates silently.

## Tiltmeter

- Size: 3-by-12-inch device.
- Fastens to an interior wall, generally in basements, with bolts or brackets.
- Electronically transmits data to project team.

## Monitoring plan features

**Building monitoring:** We have outfitted nearly 200 buildings along the tunnel route with equipment to measure movement. All buildings have monitoring points installed on the exterior, and a limited number require equipment on the inside, typically in the basement. Data is being collected around-the-clock. If any movement is detected, project staff will be alerted immediately.

**Ground monitoring:** More than 700 underground monitoring instruments are installed in the streets and sidewalks along the tunnel route. These instruments will track any movement below the surface during tunneling.

**Equipment installation, maintenance and removal:** We are coordinating with property owners for installation and removal of monitoring equipment. During tunneling, some maintenance and readings may require that we have periodic access to the monitoring equipment. After tunneling, all buildings, streets and sidewalks will have equipment removed and be restored to their original condition. Installation of equipment and restoration of historic buildings will be consistent with federal and local preservation standards.

**Schedule:** Installation of monitoring equipment began in spring 2012 and continued through summer 2013. We collected six months of baseline data of naturally-occurring earth movement before tunneling started. We will continue collecting readings for about six months after tunneling is complete to ensure there is no delayed movement, after which the equipment will be removed.

# Other tools used to monitor settlement

## Satellite imaging

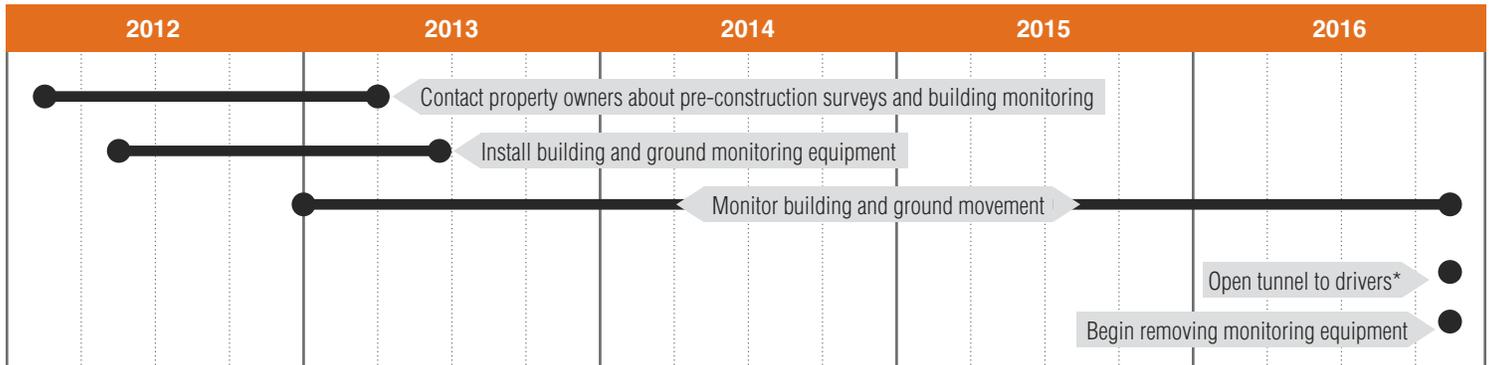
To provide a comprehensive view of buildings and structures along the tunnel route, we are using satellite imaging to collect data. Satellite images taken prior to tunnel construction create reference points for our engineers. Throughout construction, we'll use satellite imaging to assess the condition of the ground. This technology allows for precise, real-time topographic measurements and analysis of any movement, and enhances information gathered by monitoring equipment on buildings and in the ground.



## Information from the tunneling machine

By the time it's beneath downtown, the tunneling machine will dig an average of 35 feet per day. It will take approximately 10 days to pass underneath one city block. To ensure unstable voids aren't created underground, the machine is monitored in real-time. Inch-by-inch progress data is collected and analyzed by dozens of monitors on the tunneling machine, and the team is closely measuring the amount of material excavated from the tunnel.

## Timeline



\* Contingent on Seattle Tunnel Partners meeting its proposed schedule.

## For more information

<p>Visit the website at <a href="http://www.AlaskanWayViaduct.org">www.AlaskanWayViaduct.org</a>          Call the hotline at 1-888-AWV-LINE          Send an email to <a href="mailto:viaduct@wsdot.wa.gov">viaduct@wsdot.wa.gov</a>          Follow on twitter @BerthaDigsSR99</p>	<p>Send a letter to:          Alaskan Way Viaduct Replacement Program          Washington State Department of Transportation          999 Third Ave., Suite 2200          Seattle, WA 98104</p>
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## Americans with Disabilities Act & Title VI information

Americans with Disabilities Act (ADA) Information: This material can be made available in an alternate format by emailing the WSDOT Diversity/ADA Compliance Team at [wsdotada@wsdot.wa.gov](mailto:wsdotada@wsdot.wa.gov) or by calling toll free, 855-362-4ADA (4232). Persons who are deaf or hard of hearing may make a request by calling the Washington State Relay at 711.

Title VI: WSDOT ensures full compliance with Title VI of the Civil Rights Act of 1964 by prohibiting discrimination against any person on the basis of race, color, national origin or sex in the provision of benefits and services resulting from its federally assisted programs and activities. For questions regarding WSDOT's Title VI Program, contact Jonté Sulton at 360-705-7082 or [SultonJ@wsdot.wa.gov](mailto:SultonJ@wsdot.wa.gov).