STAFF SUMMARY

TO: Board of Directors
FROM: Frederick A. Laskey, Executive Director
DATE: March 13, 2024
SUBJECT: Metropolitan Water Tunnel Program
Preliminary Design and Environmental Impact Report

COMMITTEE: Water Policy and Oversight

X INFORMATION
VOTE

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Preparer/Title

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RECOMMENDATION:
For information only. This staff summary provides a summary of the preliminary design and Environmental Impact Report for the Metropolitan Water Tunnel Program (Tunnel Program).

DISCUSSION:

Preliminary Design and Environmental Impact Report Summary

On February 5, 2017, the Board of Directors approved construction of northern and southern deep rock water supply tunnels to provide needed redundancy for the Metropolitan Tunnel System. The Board directed staff to proceed with preliminary design, geotechnical investigations and Massachusetts Environmental Policy Act review of the project. These two tunnels and the related work of the Tunnel Program will provide the needed redundancy for the Metropolitan Tunnel System, which consists of the City Tunnel, the City Tunnel Extension, and the Dorchester Tunnel.

On May 27, 2020, the Board approved the award of Contract 7159, Metropolitan Tunnel Redundancy Program Preliminary Design, Geotechnical Investigation and Environmental Impact Report. As part of this contract, the Preliminary Design Report (PDR) was completed. The PDR presents the plan for approximately 15 miles of tunnels that will be constructed in rock about 250 to 500 feet below ground.

Contract 7159 also included preparation of the required Massachusetts Environmental Policy Act (MEPA) filings, and development of a comprehensive list of the environmental permits needed. The MWRA submitted an Environmental Notification Form (ENF), Draft Environmental Impact Report (DEIR), Supplemental Draft Environmental Impact Report (SDEIR), and the Final Environmental Impact Report (FEIR). Contract 7159 was completed in January 2024.

Work associated with the preliminary design and MEPA filings was performed in parallel. Several key objectives of this phase of design that were accomplished include; selection of shaft sites that meet system hydraulic requirements and provide sufficient space for temporary staging areas and permanent infrastructure; establishment of a preliminary tunnel alignment (both horizontal and

vertical) that control costs associated with mining through difficult ground conditions or requiring costly permanent liner systems; establishment of tunnel segments and construction sequencing and packaging that will promote good competition by qualified bidders; and avoidance, minimization, and mitigation of damage to the environment and impacts to the communities to the maximum extent practicable.

As the preliminary design phase progressed, certain aspects of the FY17 concept evolved with differences incorporated into the current Tunnel Program as noted herein.

Geotechnical Investigation

Subsurface investigation of ground conditions is crucial for the design and construction of the Tunnel Program. The subsurface investigations for the Tunnel Program are being performed in multiple phases to suit the advancement of the design and future construction contract documents. During preliminary design, historical data was compiled and reviewed, bedrock outcrop mapping was completed and used to inform the preliminary design of the tunnels and shafts. Given the length of the tunnels and their depth, a substantial amount of geological samples, including tens of thousands of feet of rock cores, will be collected as part of the Tunnel Program. Contract 7159 collected approximately 7,000 feet of rock core from 18 borings. Over 30,000 feet of rock core as well as other geotechnical sample data are expected to be collected for the Tunnel Program.

The proposed tunnel alignments will cross multiple major regional faults. The locations of the faults were first identified by a desktop study of geologic maps and construction records for several of MWRA's past tunnel projects. They were refined based on bedrock outcrop mapping and the geotechnical investigations. In subsequent stages of the subsurface investigations, additional work will further refine the locations and limits of the faults, as well as investigate the faults' characteristics and ultimately help control the costs of construction.

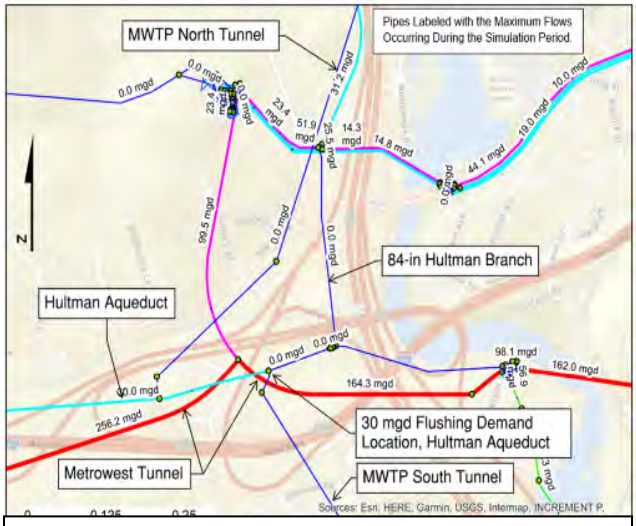
On November 16, 2022, the Board approved a lease of approximately 19,000 square feet of warehouse and office space for rock core storage at 110-116 Gould Street in Needham, Massachusetts. The Core Storage Facility provides the space needed for core storage and logging, photographing, reviewing, and processing the large amount of data in an accelerated manner.


Core Storage Facility (Needham)

Hydraulic Analysis

Hydraulic modeling was performed to support the evaluation and development of the preliminary design for the North and South Tunnel alignments that will provide a fully redundant tunnel system. The primary objective of the hydraulic modeling was to determine the required finished tunnel diameter and appropriate configurations of shafts

and connecting pipes from the new deep rock tunnels to MWRA's system and community systems. Hydraulic performance parameters included meeting target system hydraulic grade line (HGL) elevations while supplying projected design flows to customer meters (revenue meters), control valves, storage facilities, pumping stations and at other key locations in the water system. Modeling was also used to ensure the new tunnels, when in service, would not affect water age and that water quality would be maintained throughout the Metropolitan System. Hydraulic modeling confirmed that the tunnels should be sized between 10-foot to 12-foot diameter to meet the Authority's hydraulic performance goals to supply sufficient flow and pressures to its customers with the existing Metropolitan Tunnels out of service.



MWRA Hydraulic Model Near Shaft 5A

Hydraulic modeling also considered whether there would be appreciable differences in system operation considering the construction sequence of the two tunnels. As a result it was determined that early beneficial use of the South Tunnel is preferred because the South Tunnel could support greater system wide demand without requiring activation and control of the Authority's Chestnut Hill Emergency Pumping Station.

Shaft Sites and Tunnel Alignment

The tunnels will be integrated into the existing water transmission and distribution system by installing pipelines between shafts on the new tunnels and existing system infrastructure. The location of shafts was based in part on the required hydraulic connections to the existing water transmission and distribution system and the availability of land suitable for shaft sites.

Four shafts provide connections to the Hultman Aqueduct in Weston, the WASM 3 pipeline in Waltham, and the surface pipelines near the Dorchester Tunnel in Boston. These four shafts are required as they are the terminus of each tunnel and include:

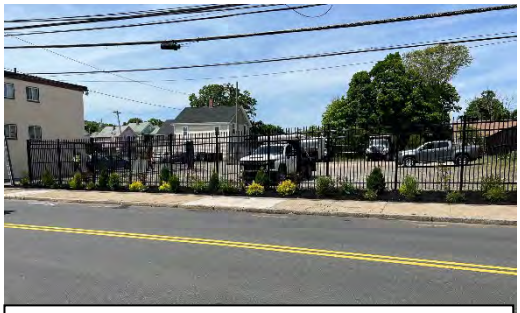
- Lower 190 Trapelo Road Property, Waverley Oaks Road Entrance (North Tunnel, Segment 1) for connection to the Weston Aqueduct Supply Main 3 (WASM 3) pipeline;
- Park Road East (North Tunnel, Segment 1) for connection to the Hultman Aqueduct;
- Park Road West (South Tunnel, Segment 2) for connection to the Hultman Aqueduct; and
- American Legion (South Tunnel, Segment 3) for connection to surface piping and the stub at Shaft 7C of the Dorchester Tunnel.

Three shafts are required on sites with sufficient space for launching of the Tunnel Boring Machines (TBMs). The three launching shafts include:

- Tandem Trailer (North Tunnel, Segment 1);
- Highland Avenue Northwest (South Tunnel, Segment 2); and
- Highland Avenue Northeast (South Tunnel, Segment 3).

This presents one additional launching shaft than envisioned in the FY17 concept. The two shafts located at Highland Avenue break up the long South Tunnel into two shorter segments allowing flexibility in the construction sequencing and mitigating schedule risk associated with potential delays during construction of a single longer tunnel heading. Notwithstanding the benefits of bisecting the long South Tunnel, shaft sites large enough to accommodate TBM launching at either end of the South Tunnel were not readily available.

Six intermediate connections along the two tunnels provide redundancy to the existing system and provide benefit to MWRA's customers by reinforcing the water system network, and to meet hydraulic and water quality performance goals. The intermediate connections connect from the deep rock tunnel through a connection shaft and surface piping to existing pumping stations or existing water mains. Intermediate connections include:



MWRA School Street Parcel (connection to Lexington St Pumping Station)

- School Street (North Tunnel, Segment 1);
- Cedarwood Pumping Station (North Tunnel, Segment 1);
- Hegarty Pumping Station (South Tunnel, Segment 2);
- St. Mary Street Pumping Station (South Tunnel, Segment 2);
- Newton Street Pumping Station (South Tunnel, Segment 3); and
- Southern Spine Mains (South Tunnel, Segment 3).

The intermediate connections to Cedarwood Pumping Station in Waltham, Hegarty Pumping Station in Wellesley, and St. Mary Street Pumping Station in Needham were not part of the original FY17 concept but they provide meaningful redundancy that would not otherwise be provided to the local communities and can be most cost effectively constructed as part of the Tunnel Program. The Cedarwood Pumping Station currently relies solely on the WASM 3 pipeline for its supply. An intermediate shaft and connection at Cedarwood Pumping Station includes provisions for a second direct connection from the North Tunnel to feed WASM 3. Both the Hegarty Pumping Station and the St. Mary Street Pumping Station intermediate connections will provide a significant operational benefit for the communities of Wellesley and Needham, respectively, as these connections will ease concern of service disruption due to the age and condition of the Section 80 pipeline, which currently supplies these two community pumping stations.

The intermediate shafts are planned to be constructed primarily using the raise bore method. This method has the advantages of requiring a small construction staging footprint as well as limiting excavated material hauling from the shaft site since most of the shaft excavate material will fall into the tunnel below and be transported to and removed at the launching shaft sites.

One additional valve chamber, the Hultman Aqueduct Isolation Valve, was also not part of the FY17 concept, but it was identified as a recommended feature in the preliminary design. It will provide additional redundancy, resiliency and security, allowing MWRA to isolate an important section of the Hultman Aqueduct that will feed the two tunnels from the Shaft 5/5A area where the MWWST, the Hultman Aqueduct and the City Tunnel all interconnect within short distances.

The preliminary design also provides permanent tunnel dewatering points to allow future draining of the North Tunnel at Tandem Trailer and draining of the South Tunnel at Highland Avenue Northeast.

Overall, the preliminary design identifies the 13 shafts required for a complete tunnel system. Although six of these shafts were not identified in the FY17 concept, they are needed to achieve required redundancy, provide benefits, or mitigate risks as described herein. Once the shaft sites were established, the primary driver for the tunnel horizontal alignment is to have the shortest tunnel length possible between shafts. However, deviations from a simple straight-line alignment between shafts are needed to facilitate construction via appropriate horizontal curves and consideration of geologic conditions, including minimizing exposure to depressions in the top of rock elevation and avoiding crossing of major faults which can result in slower and more expensive tunnel mining and necessitate construction of a steel permanent liner.

The FY17 concept generally assumed that geologic conditions would result in tunnel construction and a tunnel liner system that is consistent with the MWWST project. The geologic data collected during the preliminary design better defined those geologic conditions. The data exhibits some important differences from that of the MWWST and provides a clearer understanding of the numerous faults, such as the Northern Boundary Fault, the Western Boundary Fault and others that cannot be avoided entirely along the tunnel alignments. The additional data collected during preliminary design was used to better estimate the tunnel excavation productivity rates for mining through the variable geologic conditions. The preliminary design tunnel excavation productivity rates are lower than what was anticipated in the FY17 concept, but are reasonable, considering the geologic conditions that are now better understood.

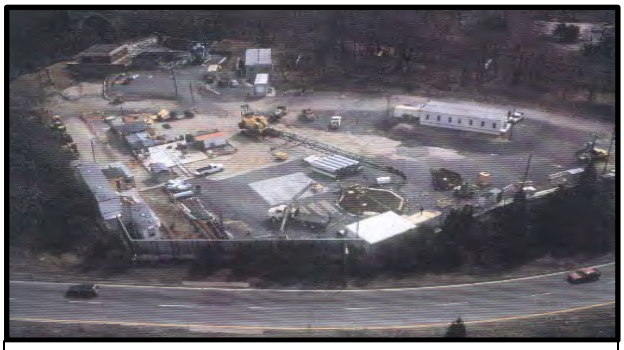
In addition to connecting to the shaft sites, the tunnel alignment avoids, to the extent possible, tunneling long distances within the influence of faults and overly variable geologic conditions. This results in an increase in the overall tunnel length by about one mile from what was anticipated in the FY17 concept, but reduces risks associated with mining through such challenging geology. The preliminary design alignment provides a net benefit to the Tunnel Program when considering the likely costs associated with tunneling through long lengths of faulted ground, and the increased contingency and potential schedule impacts.

Construction Staging Considerations

The staging area requirements for tunnel and shaft construction were factored into shaft site selection and preliminary design site layouts. Primary staging areas for tunnel construction will be at the TBM launching shaft sites. The Tunnel Program requires three TBM launching shafts as described above. Secondary staging areas will be needed at the receiving shafts at the Lower 190 Trapelo Road Property, at the west side of Park Road, and at the American Legion site. These launching and receiving shaft staging areas include space for construction activities for groundwater treatment, excavated material stockpiles, possible onsite concrete batch plants, and contractor workshops, equipment storage areas, field trailers, and construction worker parking areas. Larger staging areas are required at TBM launching shaft sites as compared to receiving shaft sites.

TBMs require a significant power supply. Selection of launching shaft sites considered the existing availability or ability to provide the required power supply to the site.

Informed by the MWWST, each TBM launching shaft site was selected in part to provide direct access to the nearest Interstate Highway System. Since each site has limited space for temporary excavated material storage, the direct highway access allows loading excavated material onto trucks with immediate access to the highway system for reuse or disposal offsite. This will greatly reduce vehicle traffic and avoid haul routes through most adjacent neighborhoods.



MWWST Shaft 5A with Highway Access

During the preliminary design, working closely with Massachusetts Department of Transportation (MassDOT) and other property owners, staff determined that several shaft sites needed alternative locations to those anticipated in the FY17 conceptual plan due to land availability. These alternative sites are equally, if not more favorably, suited for tunnel construction. For example, locating two launching shafts at the Highland Avenue interchange area complies with MassDOT's utility accommodation policy making effective use of the land that would otherwise remain underutilized. It avoids taking of other open space land that has more beneficial uses, and it has fewer community impacts during construction.

Tunnel Segments

The tunnels will be constructed in three segments (Figure 1). The North Tunnel comprises Segment 1 and extends from a connection to the Hultman Aqueduct on the east side of Park Road near a MassDOT maintenance facility building within the I-90/I-95 interchange in Weston. It will be approximately 4.8 miles long through Weston and Waltham. It will end at the Lower 190 Trapelo Road Property in Waltham where a connection to WASM 3 will be made.

The South Tunnel comprises two segments, Segment 2 and Segment 3. Segment 2 extends from a connection to the Hultman Aqueduct on the west side of Park Road in Weston. It will be approximately 3.4 miles long through Weston, Newton, Wellesley, and Needham. It will end at the northwest cloverleaf of the Highland Avenue/I-95 interchange. Approximately 0.1 miles of connector tunnel will extend to the northeast cloverleaf at the Highland Avenue/I95 interchange to connect to Segment 3.

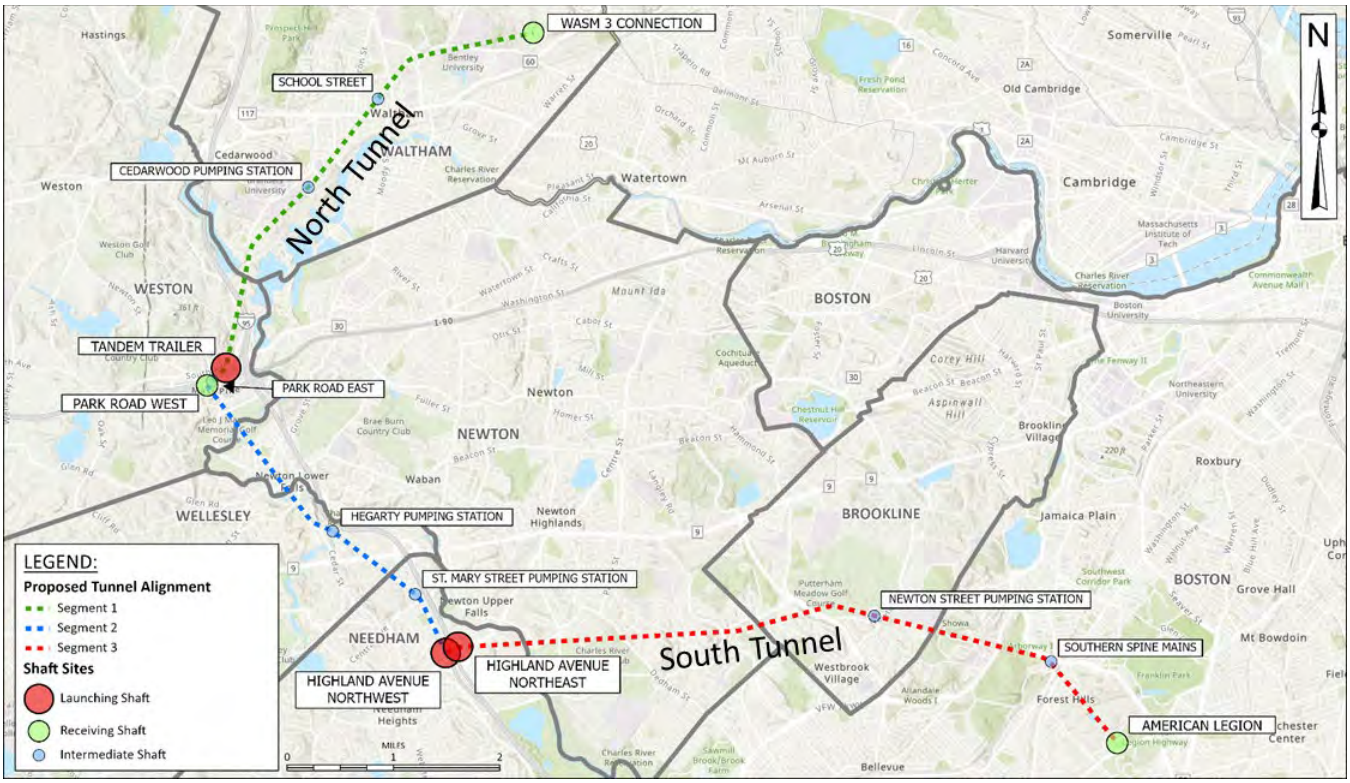


Figure 1 - North and South Tunnels

Segment 3 extends from the northeast cloverleaf of the Highland Avenue/I-95 interchange in Needham. It will be approximately 6.8 miles long through Needham, Newton, Brookline, and Boston to the proposed receiving shaft located on the north side of American Legion Highway (between Walk Hill Street and Morton Street) where connections to surface piping near Shaft 7C will be made.

When put into service, the North Tunnel and the South Tunnel may be operated independently from each other and from the Metropolitan Tunnel System and still achieve required system redundancy. Water from the Norumbega Covered Storage Facility to the west can be delivered into the North Tunnel, the South Tunnel, and the Metropolitan Tunnels. Either of these tunnel systems could be taken off-line for maintenance without interrupting service. The two segments of the South Tunnel must both be put into service together in order to provide system redundancy when the Metropolitan Tunnel System is off-line.

Tunnel Design

The tunnel design and construction approach is based on a deep rock pressure tunnel with a cast-in-place concrete lining; otherwise referred to as two-pass tunnel construction. The first pass refers to construction of the tunnel primarily using a TBM for excavation of the tunnel along with installation of temporary initial ground support. The second pass refers to installation of concrete or steel permanent final lining. The horizontal and vertical alignment of the tunnel is set to allow for a plain (unreinforced) concrete lining for most of the tunnel length taking into consideration the rock strength and rock cover along the tunnel alignments. This tunnel design and construction approach is consistent with the MWWST.

Two Pass Tunnel - Cast in Place Concrete Liner

Preliminary Design Report

The PDR documents the basis of design and summarizes field investigations, engineering analyses, preliminary design decisions and preliminary design drawings. It includes information gathered from geotechnical investigations, field surveys, hydraulic analyses, environmental evaluations, tunnel design and construction approaches, site staging for tunnel construction, operation and maintenance, land availability, permit approach, and construction cost estimate and schedules among other initial design considerations.

The PDR presents the preliminary tunnel alignment and profile, design of the valve chambers and surface pipeline connections at the shaft sites, a construction contract packaging and sequence approach, and an updated construction cost estimate and construction schedule based on the recommended contract packaging.

During the final design stage the design will progress to 100% and construction bid documents. Although some aspects of the design will evolve throughout final design (i.e., shaft site layout, valve chamber details, pipe sizes, some construction methods, limited sections of tunnel alignment), shaft site locations and functions (i.e., launching, receiving, intermediate connection), connections, dewatering and isolation points, tunnel segments, and contract packaging are not expected to change during the final design stage.

Environmental Impact Report Status

Staff submitted an ENF to the MEPA Office for public comment in March of 2021. The ENF included an Alternatives Screening Report that documented the comparison and selection of the preferred two tunnel concept to other surface pipe and tunnel alternatives. The Secretary of Energy and Environmental Affairs (EEA) issued a certificate on the ENF that required the submittal of a mandatory DEIR.

Staff submitted a DEIR to the MEPA Office for public comment on October 22, 2022. The DEIR evaluated a preferred alternative and two backup alternatives. The purpose of evaluating three alternatives equally was to help maintain the Tunnel Program schedule should aspects of the preferred alternative become not viable at a later stage of design.

The DEIR included information on the following topics for the three DEIR Alternatives:

- Project Description and Permitting;
- Public Outreach;
- Environmental Justice;
- Alternatives Analysis;
- Land Alteration, Open Space, Wetlands, Rare Species Habitat, Cultural and Historical Resources;
- Water Management Act/Water Supply;
- Climate Change (adaption and resiliency, greenhouse gas emissions);
- Construction Period Impacts; and
- Responses to ENF Comments.

Through detailed analysis performed in parallel with the preliminary design, staff determined that the temporary construction impacts were very similar across the three remaining alternatives. The preferred alternative that will be advance to final design was selected in part because it provides the most flexibility to optimize packaging and configuration and the shortest overall construction schedule. The DEIR also included Mitigation and Draft Section 61 Findings, as required by MEPA.

EEA issued a certificate on the DEIR that required the submittal of a SDEIR before the Tunnel Program could proceed to the FEIR phase. Specifically, the SDEIR was to address the availability of the proposed North Tunnel receiving shaft site at the Fernald Property in Waltham, which was common to all three alternatives included in the DEIR, and to analyze and present any potential alternative receiving shaft locations. In addition, the SDEIR was to respond to comments on the DEIR received as part of the public comment and to supplement environmental justice and greenhouse gas analysis presented in the DEIR.

Staff submitted a SDEIR to the MEPA Office for public comment on July 31, 2023, which presented two alternative shaft sites in Waltham for the end of the North Tunnel. Two alternatives included a parcel on Beaver Street owned by the University of Massachusetts and one alternative included a different area on the Lower 190 Trapelo Road Property (referred to as the Lower Fernald Property in the SDEIR filing). The SDEIR evaluated the two new sites consistent with the methodology and criteria used in the DEIR.

EEA issued a certificate on the SDEIR that allowed the Tunnel Program to proceed to the FEIR phase and required that the FEIR address all comments received on the SDEIR. Staff submitted the FEIR to MEPA on February 15, 2024, notified nearly 200 stakeholders of its availability, and delivered hard copies to ten public libraries. Public comments are due to MEPA by March 25, 2024 and a certificate is expected in early April. The FEIR included Alternative 4B as the preferred alternative. This alternative is very similar to the preferred alternatives in the DEIR and SDEIR, with the most significant change being the terminus of the North Tunnel. The FEIR preferred

alternative, and the one that will be carried into final design includes a receiving shaft at the Lower 190 Trapelo Road Property in Waltham.

Community and Stakeholder Outreach

Staff have implemented a communication plan to ensure that communities and stakeholders are informed as to the importance of this effort and what can be expected in the years ahead. Staff have been coordinating with a working group that includes representatives of each of the ten communities in the Tunnel Program study area, the MWRA Advisory Board, the Water Supply Citizens Advisory Committee and the Metropolitan Area Planning Council. This working group was particularly active in the planning phases of the Tunnel Program and the environmental review process as staff were evaluating shaft sites and tunnel alignments. Ongoing coordination with the working group members has been primarily to provide Tunnel Program updates with a focus on field work and other Tunnel Program related activities planned in the communities. Staff will continue to collaborate with the working group members as the Tunnel Program moves through final design.

Further, staff are holding additional meetings with community representatives from the seven municipalities where the tunnel will be constructed. Staff have been meeting with individual property owners in support of the geotechnical exploration program. Coordination meetings with public safety personnel from several communities has begun and will continue through design and construction to ensure the safety of the public as well as the workers who will construct the tunnels. To date, staff have held over 140 meetings with various community representatives, state agencies, stakeholders, and property owners.

Staff will hold broader public information sessions starting in 2024 with a variety of topics to keep the sessions to a reasonable timeframe. Topics may include a Tunnel Program overview, an overview of tunneling methods (i.e. “Tunneling 101”) and associated construction period impacts such as traffic, noise and vibration, and other topics of interest to stakeholders. As design and/or construction progresses, these public sessions may be split to focus on the North Tunnel and the South Tunnel, given the geographic area and the schedules associated with each tunnel. Additionally, staff will continue to hold public information sessions and/or workshops as requested by communities or other stakeholders. Staff are also looking at opportunities to engage local schools and other community-based organizations as the Tunnel Program moves forward.

A key goal of the public outreach plan is ensuring participation of members of environmental justice populations throughout all phases of the Tunnel Program. This includes improving the accessibility of information within the communities through appropriate public notices ahead of public meetings, dissemination of fact sheets, hosting relevant information on the Tunnel Program website, providing translation and interpretation services in the prevalent languages within the communities, and utilizing non-traditional media sources. Staff will employ additional methods of engagement as the Tunnel Program progresses with feedback from stakeholders and in alignment with MWRA’s overall environmental justice strategy. Moreover, staff will work with community representatives and community-based organizations to determine the most effective means of communication and notification to environmental justice populations.

BUDGET/FISCAL IMPACTS:

The proposed FY25 CIP includes $2.1 billion for the Metropolitan Water Tunnel Program. This budget will be refined periodically during Final Design.

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03/13/2024

Presentation to

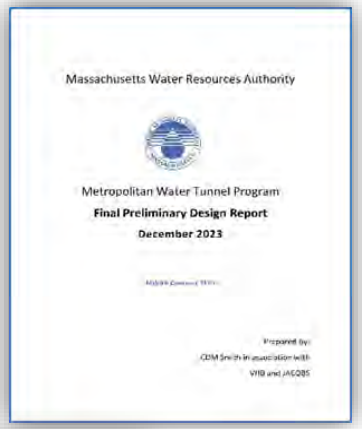
MWRA Board of Directors

Metropolitan Water Tunnel Program Preliminary Design and Environmental Impact Report

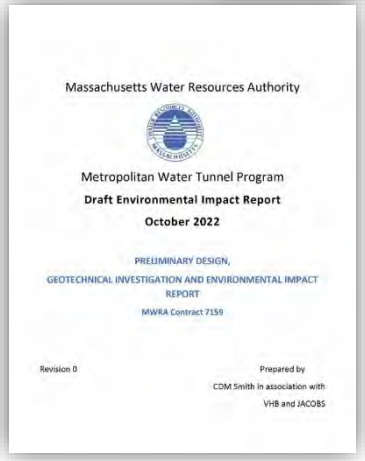
March 13, 2024

Preliminary Design and Environmental Impact Report

- Preliminary Design Report
  - 15 miles of deep rock tunnel
  - 100 Year Service Design Life
  - Preliminary tunnel alignment and profile, valve chambers and surface pipeline connections
  - Construction contract packaging and sequence approach
  - Updated construction cost estimate and construction schedule



- MEPA filings and Environmental Impact Reports
  - Environmental Notification Form
  - Draft Environmental Impact Report
  - Supplemental Draft Environmental Impact Report
  - Final Environmental Impact Report
  - FEIR submitted to EEA February 2024



Preliminary Design & EIR – Performed in Parallel

Key Objectives:

- Shaft site selection
  - Meet system hydraulic requirements, provide full redundancy
  - Provide sufficient space for temporary construction staging and permanent infrastructure
- Establish tunnel alignment (both horizontal and vertical)
  - Minimize overall tunnel length
  - Avoid geo-hazards when possible
  - Maximize length of unreinforced concrete liner
  - Establish readily constructible tunnel segment lengths
- Avoid, minimize, and mitigate impacts to the environmental and communities to the maximum extent practicable
- Establish construction sequence and packaging
  - Promote good competition by qualified bidders
  - Balance risks

Shaft Site Selection Objectives

- During Construction
  - Sufficient size for construction
  - Locate away from sensitive receptors and abutters
  - Close to major highway
  - Near receiving water
- After Construction
  - Landscaped and secured
  - Periodic site visits and maintenance
  - Good neighbor

Shaft Site During Construction

Shaft Site After Construction

Shaft Sites

Construction Shaft Sites

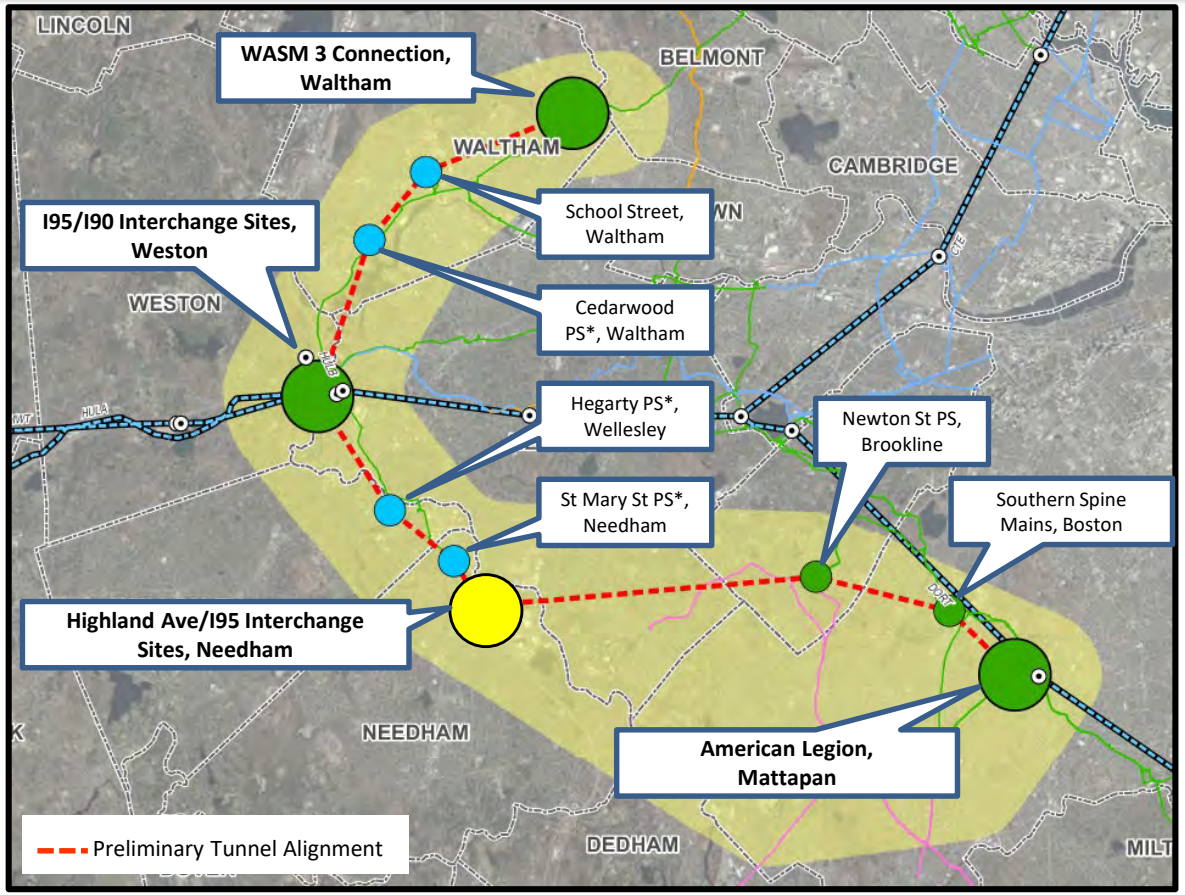
- WASM 3 Connection, Waltham
- I90/I95 Interchange, Weston
- Highland Ave/I95 Interchange, Needham
- American Legion, Mattapan

Connection Shaft Sites

- Lexington St Pump Station, Waltham
- Cedarwood Pump Station, Waltham
- Hegarty Pump Station, Wellesley
- St. Mary Street Pump Station, Needham
- Newton Street Pump Station, Brookline
- Southern Spine Mains, Boston

Final shaft locations subject to permits and real estate acquisition

* Non MWRA Pump Station

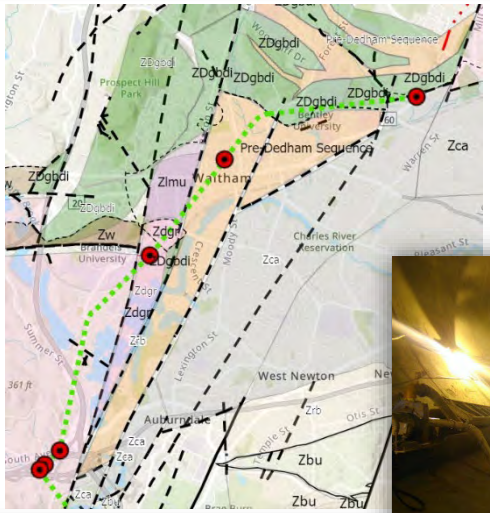


Required Connection (required for system redundancy)
Secondary Connection (provides local benefit)
Construction Shaft (South Tunnel Isolation)

Tunnel Alignment & Segments

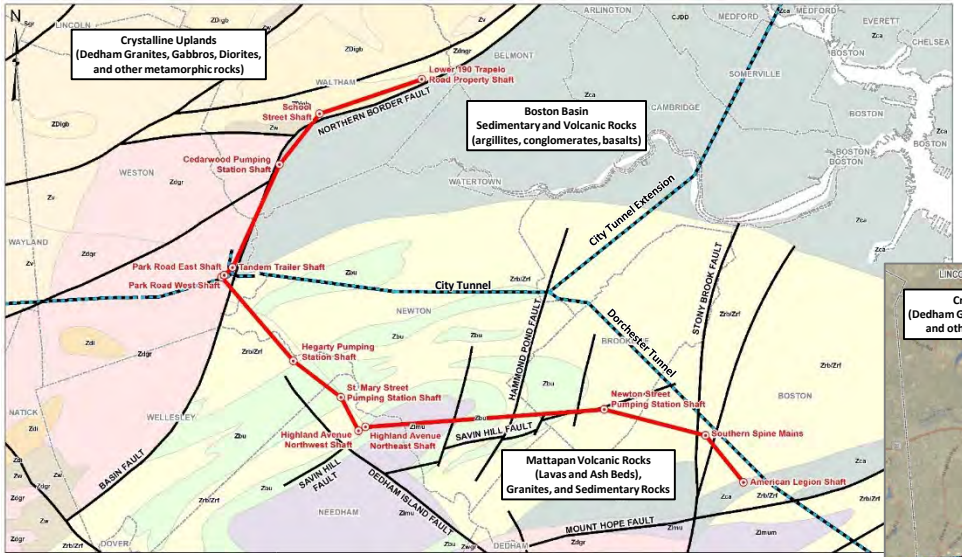
Objective:

- Establish tunnel alignment (both horizontal and vertical) to minimize overall length and maximize unreinforced concrete permanent liner system
- Avoid/minimize mining through difficult ground conditions where possible
- Select segment lengths to shorten overall construction duration and provide added operational flexibility
- Control construction costs by combining tunnel segments into contract packages that minimize contract interfaces and encourage construction flexibility



Geologic Conditions Influence Tunnel Alignment and Construction

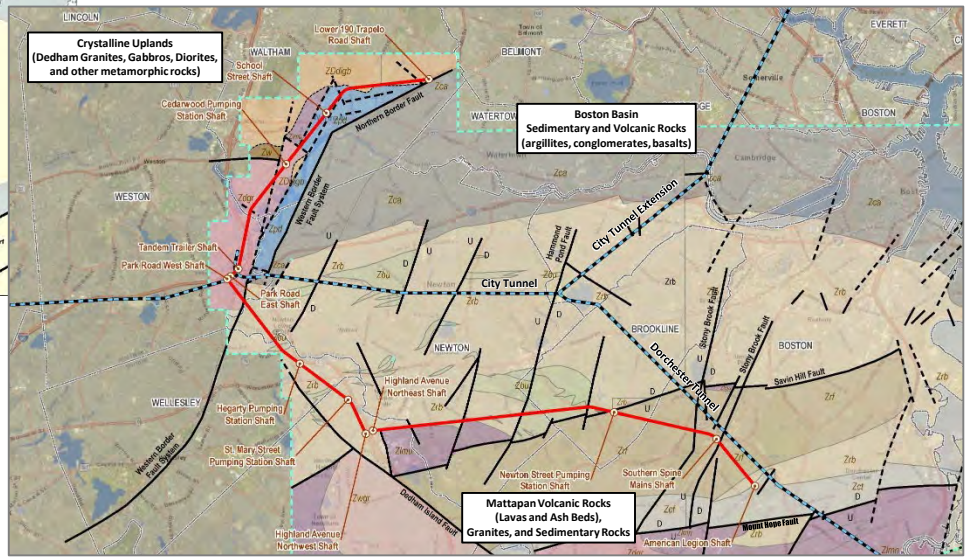
Beginning of Preliminary Design



- Crossing 4 major fault systems
- Poor quality rock w/ thick overburden found in Waltham
- Adjusted tunnel alignment to avoid geo-hazards
- Adjusted estimated tunnel mining production rate to reflect conditions

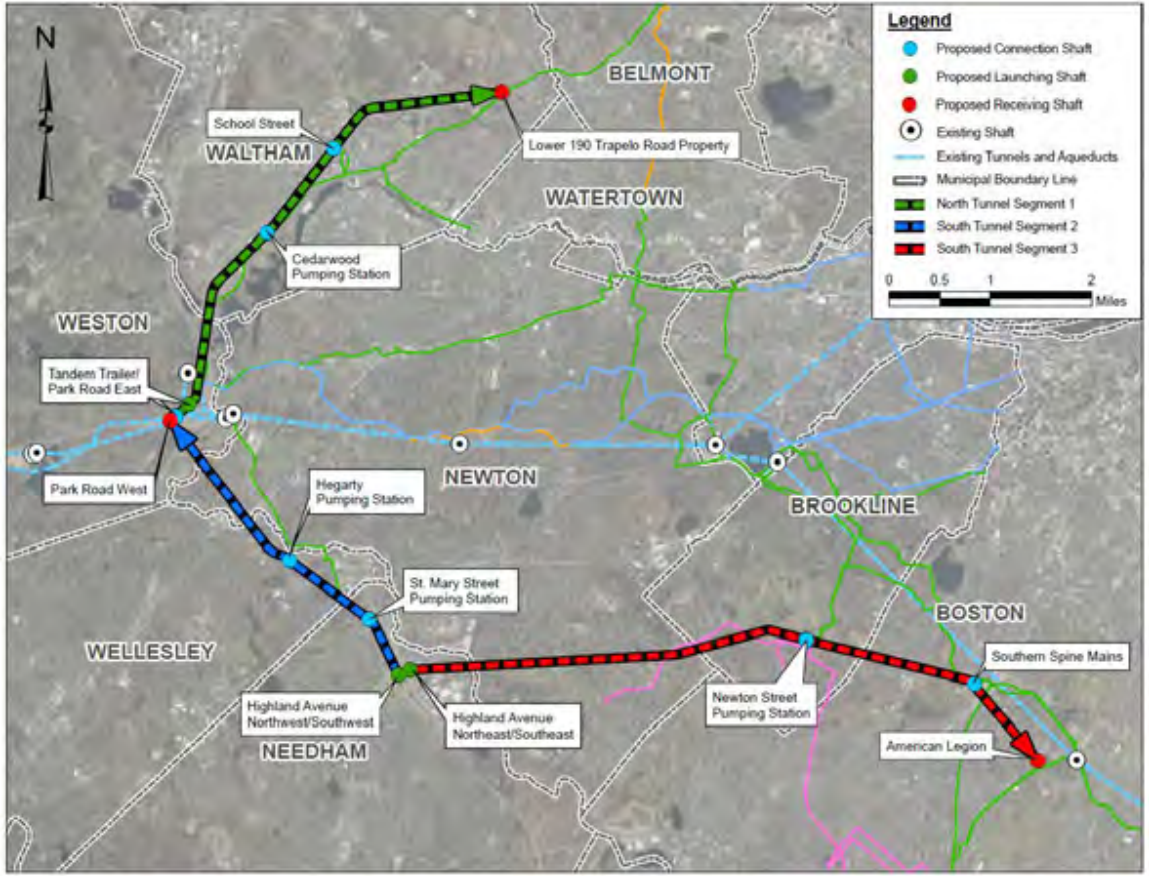
Final Design Stage geotechnical investigations will add to our understanding of geologic conditions and will be used to refine tunnel alignment, construction methods, schedule and costs

End of Preliminary Design



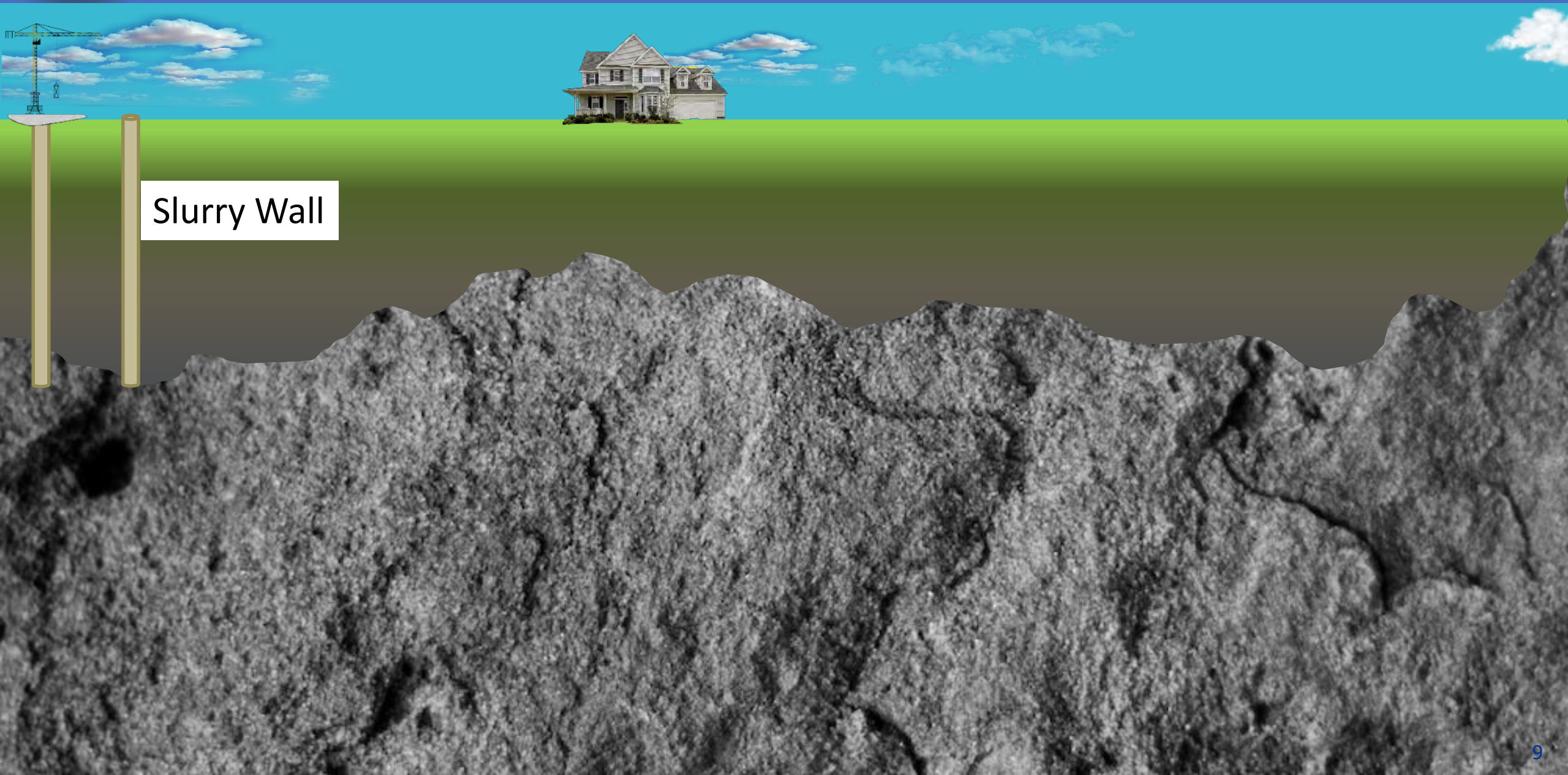
Tunnel Alignment, Segments, and Contract Packaging

- 15 miles of deep, hard rock, pressure tunnel, 250 to 500 feet deep
- Three launching and three receiving shafts
- Three tunnel segments (4.8, 3.4 and 6.8 miles long)
- Six intermediate connection shafts
- Alignment has been adjusted to avoid known geo-hazards
- Two tunnel construction packages
  - North Tunnel (Segment 1)
  - South Tunnel (Segments 2 & 3)
- Contract package sizes should promote good competition



Tunnel Construction

Tunnel Construction



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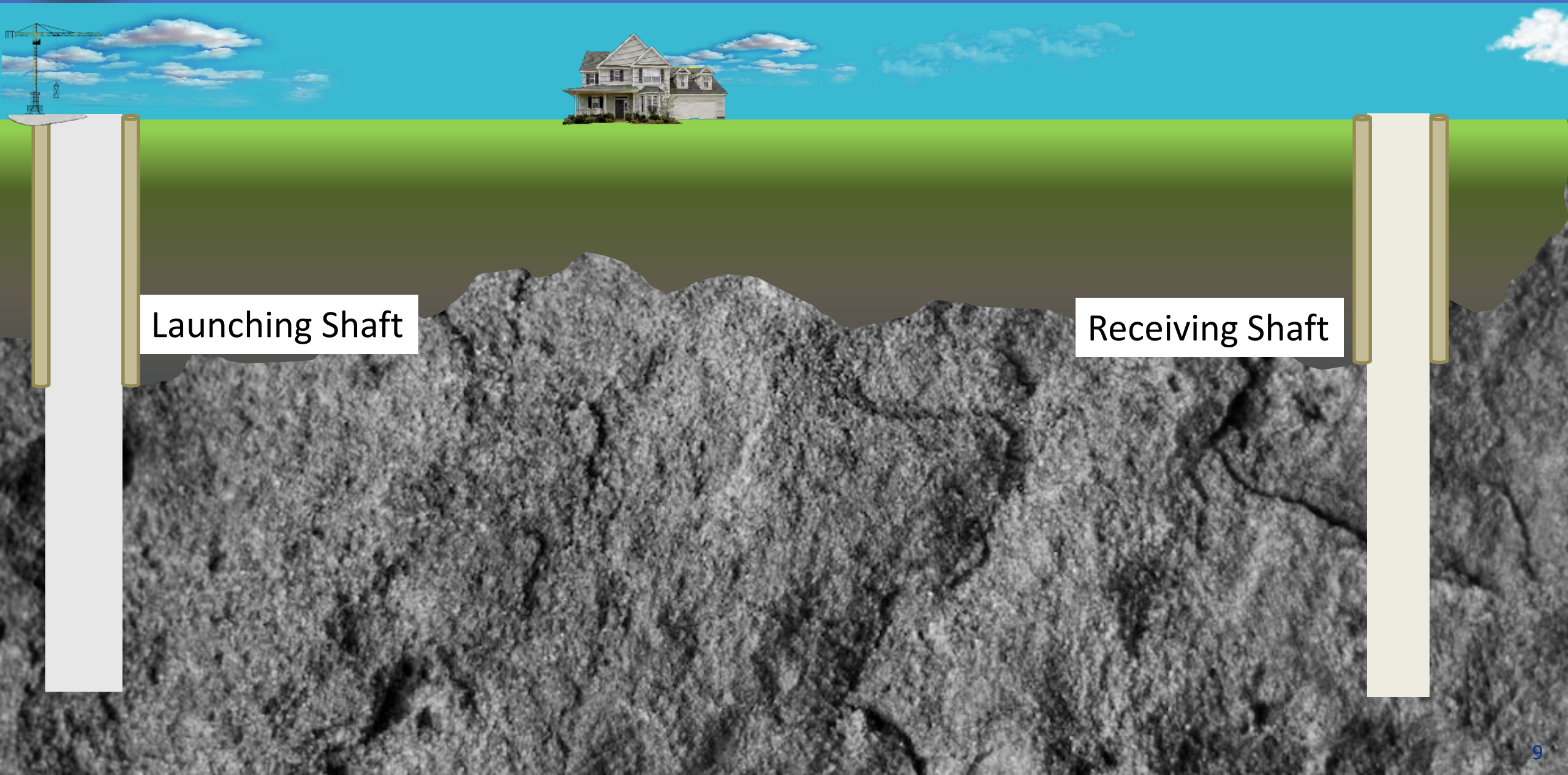
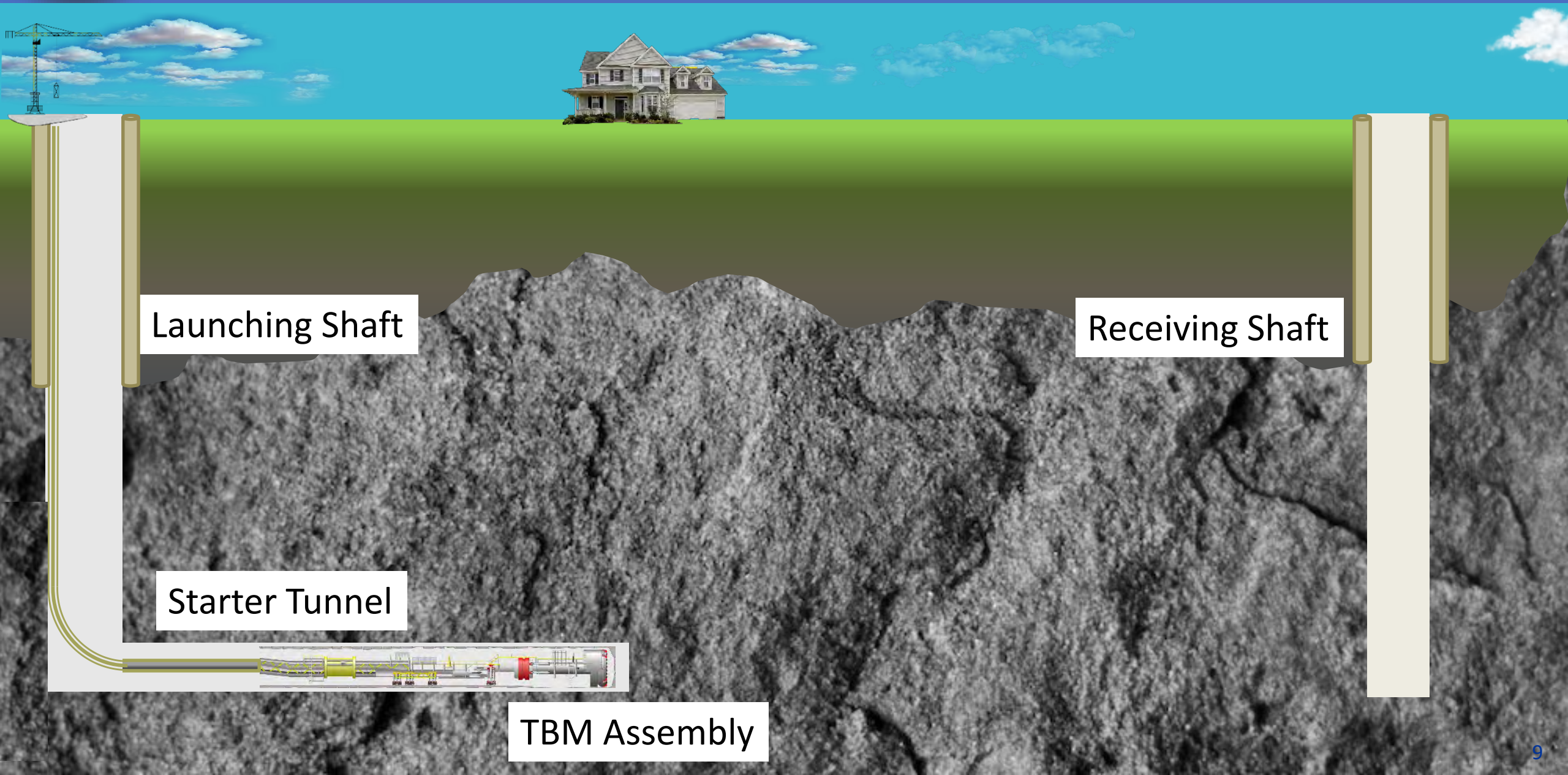
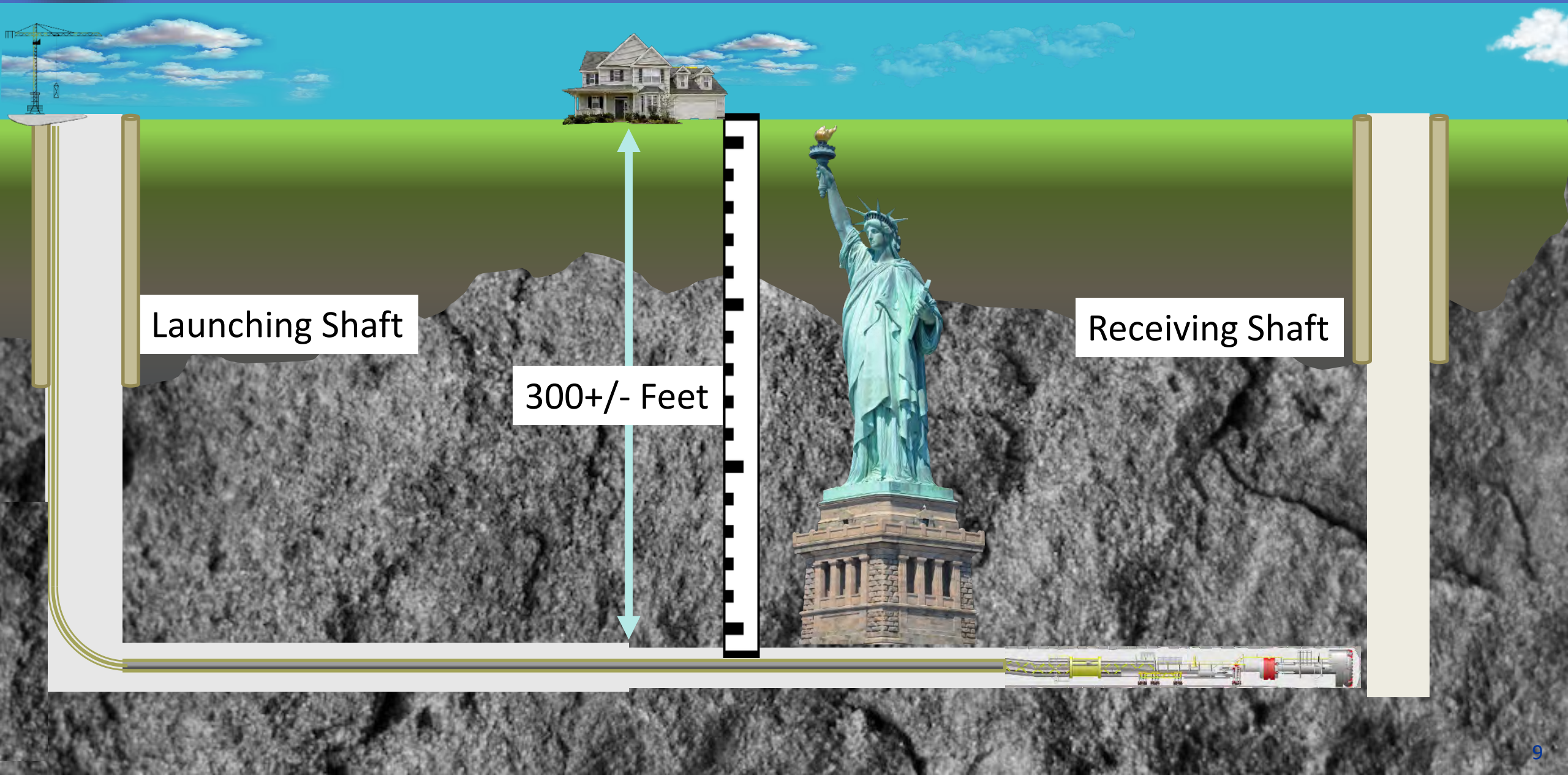


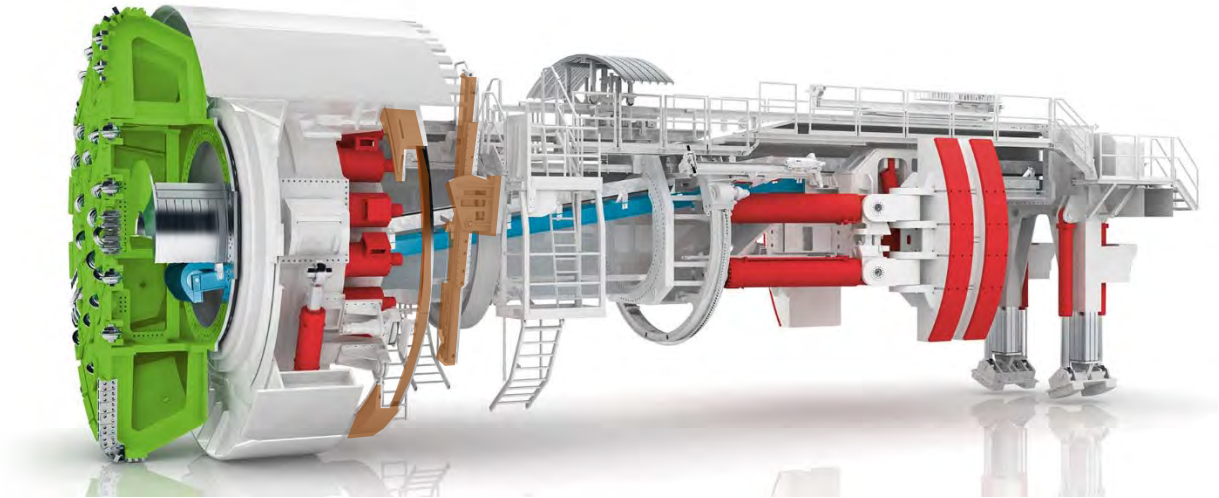
Tunnel Construction



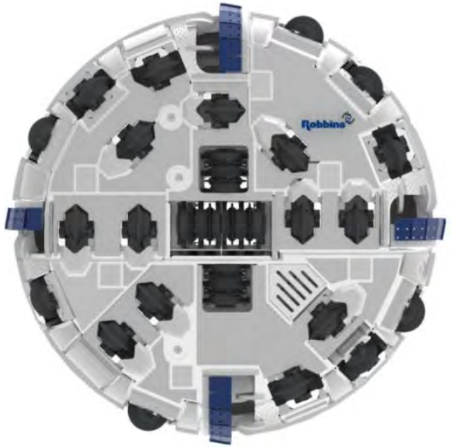
Tunnel Construction



Tunnel Boring Machine

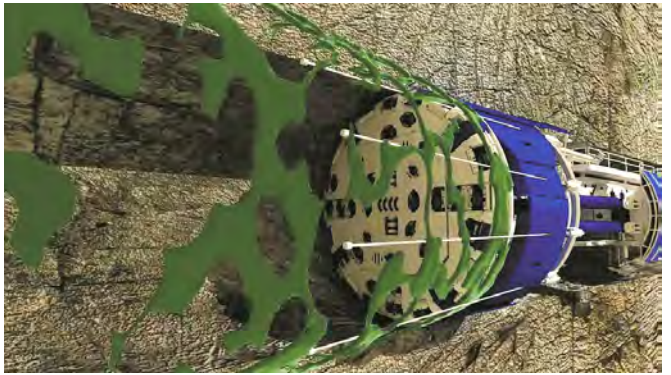


Source: www.herrenknecht.com



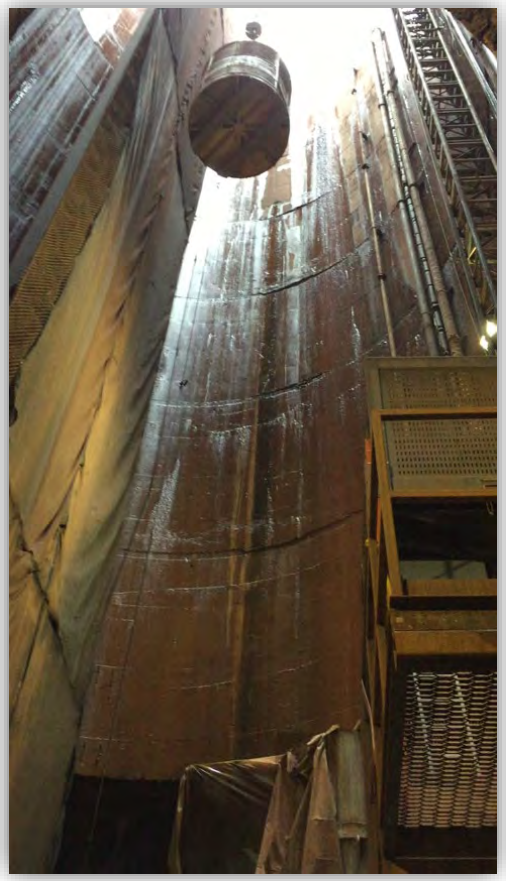
Source: www.robbins.com

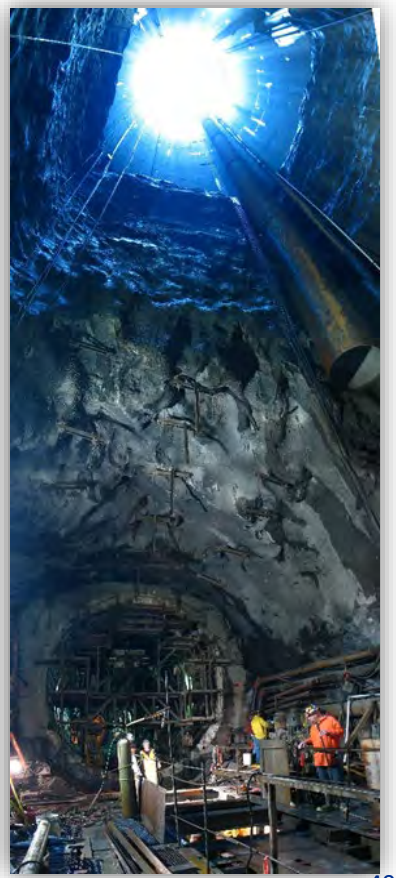
- Cutterhead grinds the bedrock into small pieces
- Conveyors move the broken rock to the back of the TBM
- Self propelled grippers push to side of tunnel, jacks propel forward
- Bedrock is self supporting or supported with rib (rib erector), rock bolts (rock drill), and shotcrete
- Probing and grouting is used to control groundwater



Launching / Receiving Shaft Construction

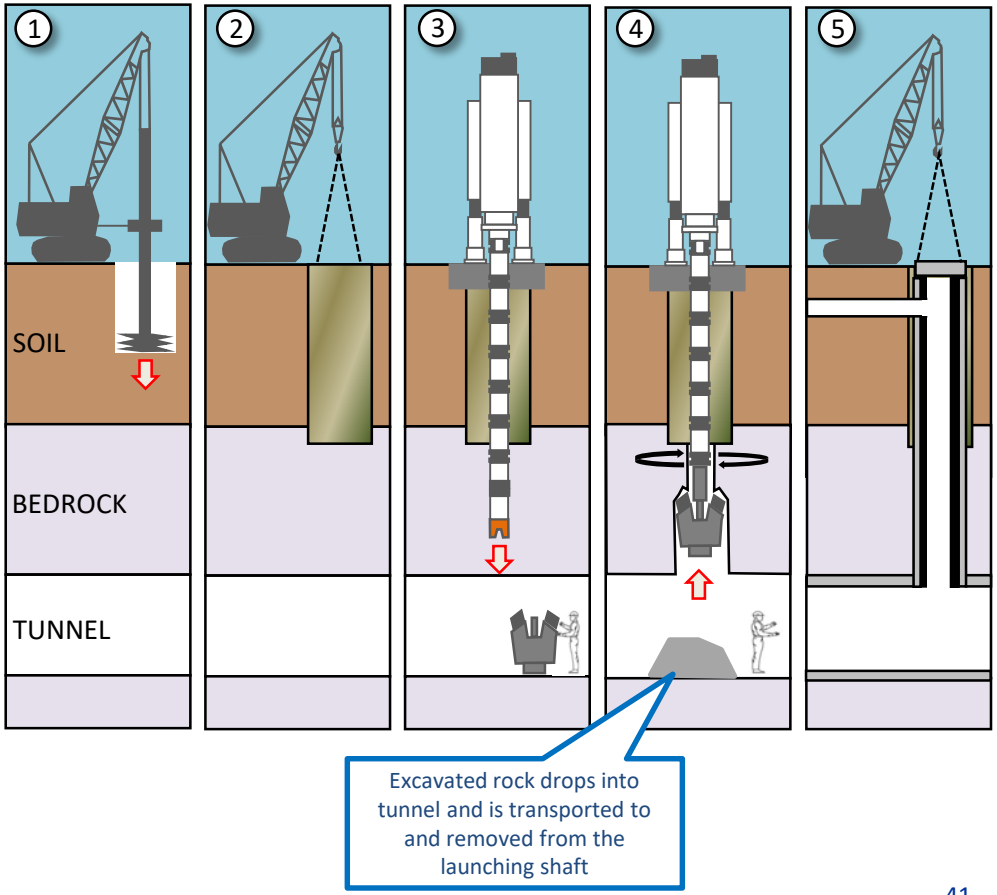
- ~25’ – 40’ diameter, ~250’ – 400’ deep
- Launching shaft is the only access to the tunnel until breakthrough into the receiving shaft
- Constructed by drill and blast methods
- “Cavern” at the bottom of launching shaft is where TBM will be assembled





Intermediate Shaft Construction

- Intermediate connection shafts are smaller diameter
- Use raised bore shaft construction method where possible
- Sequence of Construction (after tunnel has passed below):
  - (1) Auger drill through soil
  - (2) Install steel casing through soil
  - (3) Drill pilot hole in rock
  - (4) Ream larger hole in rock – **spoil drops into and is removed from the tunnel**
  - (5) Install shaft lining
- Benefits of Raised Bore Shaft Method:
  - Smallest footprint at the surface
  - Most excavate is removed from inside the tunnel which limits hauling from the site
  - No blasting
  - Not 24/7



Potential Permits and Approvals

Federal

- National Pollutant Discharge Elimination System (NPDES) Construction General Permit (CGP)
- NPDES Dewatering and Remediation General Permit (DRGP), if needed
- Section 404 Department of the Army Permit (General and Preconstruction Notice)

Commonwealth of Massachusetts

- Massachusetts Environmental Policy Act (MEPA) Review
- Massachusetts Historical Commission (Massachusetts General Law Ch. 9, Section 26-27C)
- Highway Access/Construction Access Permits
- MBTA Right of Way Access License Agreement
- Natural Heritage Endangered Species Program
- Water Management Act Permit
- Chapter 91 Licenses
- Superseding Order of Conditions, upon appeal
- Section 401 Water Quality Certificate
- Distribution System Modification
- Land disposition/easements
- Article 97 Land Disposition Legislation

Municipal

- Wetlands Protection Act Order of Conditions
- Roadway Access Permits/Street Opening Permit
- Hydrant Permit
- Drainage Discharge Permit

Environmental and Community Impacts

Avoid, minimize, and mitigate impacts to the environmental and communities to the maximum extent practicable:

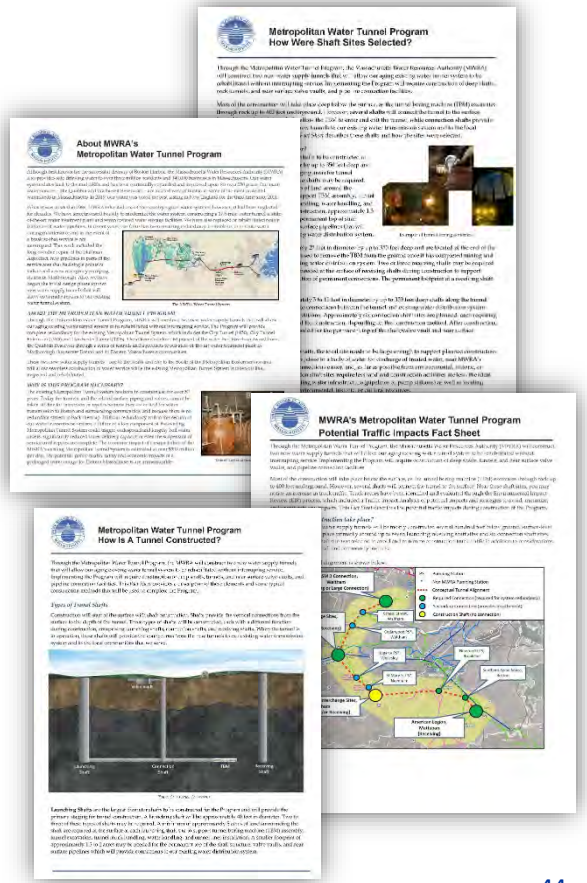
- Shaft site selection considered land use, traffic, noise, hauling routes, proximity to sensitive receptors, EJ communities, etc.
- Prioritized public land (MWRA, DCR, MassDOT) and communities that directly benefit from the Tunnel Program
- Construction methods selected to minimize impacts where possible (e.g., TBM, raise bore shaft construction method)
- Solicited stakeholder input throughout the process to help understand impacts and inform decisions
- Locating launching shaft sites along major highways and near receiving water was key to minimizing impacts
- Shaft sites selected should avoid the need for costly mitigations

Construction impacts are temporary

Redundant water supply is a long-term benefit

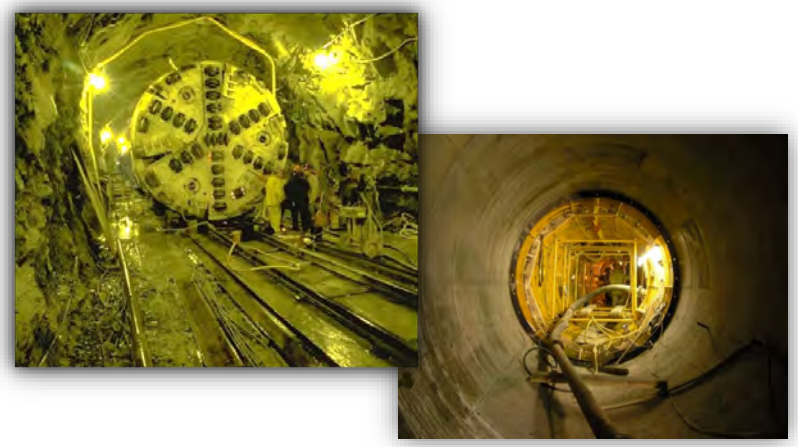
Community & Stakeholder Outreach

- Met with 10 communities in the study area
- Established a Working Group with representative from each community
- Numerous meetings with the 7 communities in which the tunnel will be constructed:
  - Town Management, Public Works, Public Safety/Fire, Conservation Commission, etc.
- Multiple meetings with key stakeholders and permit agencies:
  - EEA, DEP, MassDOT, DCR, DPH, DYS, UMass and DCAMM
- Met with numerous organizations, businesses & private property owners to coordinate field work
- Met with community interest groups
  - WLT, CRWA, neighborhood groups and others
- Established a Website https://www.mwra.com/mwtp.html and email address (for questions) Tunnels.info@mwra.com
- Created multiple Fact Sheets – available in 4 languages
- Outreach will continue throughout design and construction



Key Characteristics of the 2017 Two-Tunnel Concept Maintained

- Hard rock pressure tunnels
- Two separate tunnels:
  - One begins in Weston and ends in Waltham (North Tunnel)
  - One begins in Weston and ends in Mattapan (South Tunnel)
- TBM excavation with two pass construction method
- Set horizontal and vertical alignment to maximum unreinforced concrete liner, limit steel liner
- Probing and grouting to control ground water
- Buried top of shaft structures and valve vaults
- Meets goal of full redundancy



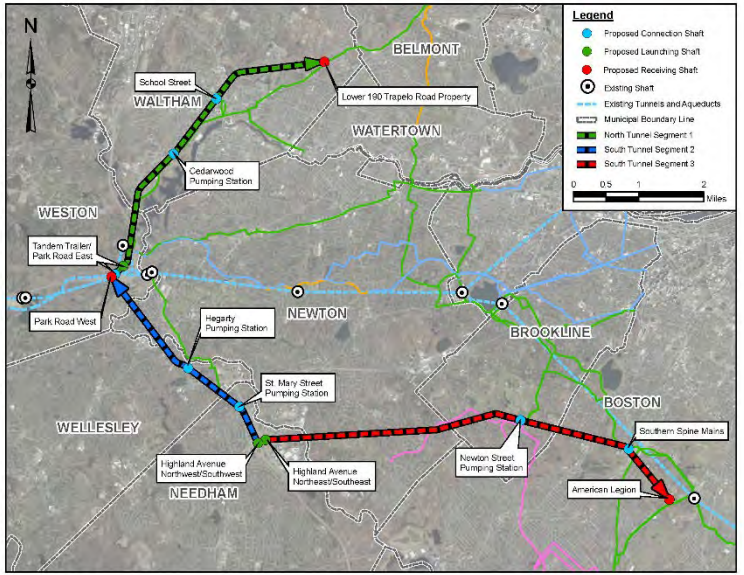
Key Changes Since 2017 Concept

2017 (Two-Tunnel Concept):

- 14 miles, 2 segments, 2 TBM's
- Four intermediate shaft
- One double launching shaft site at I90/I95
- Two receiving shafts (Waltham & Mattapan)

2023 (Preliminary Design / FEIR):

- Accounts for land availability and environmental impacts
- Accounts for geologic conditions
- 15 miles, 3 segments, 2 or 3 TBM's
- Six intermediate shafts, 1 large connection shaft, 2 connector tunnels
- Two launching shaft sites at Highland Ave, one at I90/I95
- Three receiving shafts (Waltham, I90/I95, Mattapan)



2017 Two-Tunnel Concept vs. 2023 Preliminary Design/FEIR

- Benefits of 2023 Configuration:
  - Improves construction packaging
  - Reduces construction schedule
  - Reduces construction contract interfaces
  - Reduces risks
  - Improves community supply resilience
  - Provides added long-term operations capability
- Accounts for land availability
- Accounts for geologic conditions
- Avoids/minimizes/mitigates environmental and community impacts, to the extent practical
- Prioritizes construction sequence to match largest need for redundancy (South Tunnel first)
- Establishes construction contract packaging that should promote good competition
- Constructible tunnel system that will meet redundancy goals