# Metro

*Los Angeles County Metropolitan Transportation Authority*
*One Gateway Plaza*
*3rd Floor Board Room*

## Agenda - Final

**Thursday, May 19, 2016**

**9:00 AM**

**One Gateway Plaza, Los Angeles, CA 90012,**
**3rd Floor, Metro Board Room**

## Construction Committee

***Don Knabe, Chair***
***Jacquelyn Dupont-Walker, Vice Chair***
***Mike Bonin***
***Diane DuBois***
***Ara Najarian***
***Carrie Bowen, non-voting member***
***Phillip A. Washington, Chief Executive Officer***

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a. Disorderly behavior toward the Board or any member of the staff thereof, tending to interrupt the due and orderly course of said meeting.
b. A breach of the peace, boisterous conduct or violent disturbance, tending to interrupt the due and orderly course of said meeting.
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**NOTE: ACTION MAY BE TAKEN ON ANY ITEM IDENTIFIED ON THE AGENDA**

## CALL TO ORDER

## ROLL CALL

**16. APPROVE Consent Calendar Item: 17.**

**Consent Calendar items are approved by one motion unless held by a Director for discussion and/or separate action.**

CONSENT CALENDAR

**17.** RECEIVE AND FILE status update report on the **Project Labor Agreement and Construction Careers policy programs through the quarter ending March 2016**. 2016-0255

***Attachments:*** PLA CCP Report, Data through March 2016

NON-CONSENT

**18.** RECEIVE AND FILE the **quarterly status report on the Airport Metro Connector** (AMC) including clarification on the project's target delivery date in response to the April 2016 Board Motion (Attachment A). 2016-0315

***Attachments:*** Attachment A - April 28, 2016 Board Motion.pdf

Attachment B - June 2014 Board Motion.pdf

**(ALSO ON PLANNING AND PROGRAMMING COMMITTEE)**

**19.** RECEIVE **Oral Report by the Program Management Executive Director.** 2016-0363

***Attachments:*** Attachment A - Program Management Executive Directors Report - May 2016

Attachment B - Project Status Sheets - May 2016.pdf

**20.** AUTHORIZE the CEO to execute Contract Modification No. 24 to Contract No. E0119 with the **Connector Partnership Joint Venture (CPJV) Inc. to continue providing Design Support Services during Construction through FY17 for the Regional Connector Transit Corridor Project** (Project), in the amount of $5,565,000 increasing the total contract value from $62,742,374 to $68,307,374. This action does not increase Life of Project Budget. 2016-0334

***Attachments:*** Attachment A - Procurement Summary
Attachment B - Contract Modification Authority(CMA) Summary
Attachment C - DEOD Summary

**21.** AUTHORIZE the Chief Executive Officer to execute Amendment No. 1 to the existing Memorandum of Understanding between **Metro and the Los Angeles County Museum of Natural History, including the Page Museum at the La Brea Tar Pits, for the preservation and storage of paleontological and archaeological resources associated with the Westside Purple Line Extension Section 1 Project**. 2016-0326

***Attachments:*** Attachment A - Amendment 1 to MOU between Metro and the Los Angeles Cou
Attachment B - Memorandum of Understanding between Metro and the Los Anc

**22.** AUTHORIZE the Chief Executive Officer to execute: 2016-0101

A. Modification No. 3 to Contract No. PS8610-2879, **with Hill International, Inc. for Program Control Management and Support Services**, to exercise the final one-year option thereby extending the period of performance from June 28, 2016 to June 28, 2017, and increase the total contract not-to-exceed amount $6,210,946 from $18,482,598 to $24,693,544; and

B. individual Contract Work Orders (CWOs) and Contract Modifications within the Board approved not-to-exceed contract value.

***Attachments:*** Attachment A - Procurement Summary PCMS
Attachment B - Contract Work Order and Modification Log PCMS
Attachment C - DEOD Summary PCMS

**23.** CONSIDER: 2016-0365

A. INCREASING the Life of Project budget for Project 809081, Red Line Segment 2 Close-out in the amount of $635,000 increasing the previous authorization amount of $31,847,1000 to $32,482,100;

B. AMENDING the FY16 budget to add $635,000 to Project 809081, Red Line Segment 2 Close-out;

C. INCREASING the Life of Project 809082, **Red Line Segment 3 Close-out** in the amount of $211,670, increasing the previous authorization amount of $4,195,900 to $4,407,570; and

D. AMENDING the FY16 budget to add $211,670 to Project 809082, Red Line Segment 3 Close-out.

**36.** AUTHORIZE the Chief Executive Officer (CEO) to: 2016-0250

A. ADOPT a Design Life or Project Budget for $11,078,366 for the **I-210 Barrier Replacement Project to develop a Risk Assessment Study, Environmental Clearance and Final Design documents** for future construction consideration;

B. AMEND FY16 Budget by $553,918 and AMEND FY17 Proposed budget by $9,970,529 to fund aforementioned efforts;

C. AWARD AND EXECUTE a fourteen-month labor hour Task Order No. 12 for Contract No. PS4730-3070. Highway Programs on-call support services, to CH2M Hill Inc. in an amount not-to-exceed $4,799,967 for Architectural and Engineering (A&E) services for the preparation of the Project Report and Environmental Documents (Categorical Exemption) and the Plans, Specifications and Estimates for the Metro Gold Line Interstate 210 Barrier Replacement; and

D. EXECUTE Modification No.1 to Contract No. PS4730-3070 to increase the not-to exceed value by $4,799,967 from $10,000,000 to $14,799,967.

***Attachments:*** ATTACHMENT A-Design Life of Project Cost Estimate
AtTTACHMENT B Procurement Summary
ATTACHMENT C -Task Order Log.pdf
ATTACHMENT D-DEOD Summary

## Adjournment

Consideration of items not on the posted agenda, including: items to be presented and (if requested) referred to staff; items to be placed on the agenda for action at a future meeting of the Committee or Board; and/or items requiring immediate action because of an emergency situation or where the need to take immediate action came to the attention of the Committee subsequent to the posting of the agenda.

Los Angeles County
Metropolitan Transportation
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One Gateway Plaza
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Los Angeles, CA

Metro

# Board Report

**File #:** 2016-0255, **File Type:** Informational Report **Agenda Number:**

**CONSTRUCTION COMMITTEE**
**MAY 19, 2016**

**SUBJECT: PROJECT LABOR AGREEMENT/CONSTRUCTION CAREERS POLICY (PLA/CCP) REPORT (DATA THROUGH MARCH 2016), AND 12-MONTH PILOT LOCAL HIRE INITIATIVE**

**ACTION: RECEIVE AND FILE**

## RECOMMENDATION

RECEIVE AND FILE status update report on the **Project Labor Agreement and Construction Careers policy programs through the quarter ending March 2016**.

## ISSUE

In January 2012, the Board approved the Project Labor Agreement with the Los Angeles/Orange Counties Building and Construction Trades Council and the Construction Careers Policy. One benefit of the PLA is to encourage construction employment and training opportunities in economically disadvantaged geographic areas throughout the United States. Another benefit of the PLA is that work stoppages are prohibited.

Consistent with the Board approved PLA and CCP, prime contractors are required to provide Metro with monthly reports detailing progress towards meeting the targeted worker hiring goals. Additionally, consistent with Metro's Labor Compliance policy and federal Executive Order 11246, the prime contractors provide Metro with worker utilization data by ethnicity and gender.

The attached report provides the current status (through March 2016) of construction projects subject to the PLA/CCP.

## DISCUSSION

There are eight active construction contracts and nine completed contracts with the PLA/CCP program requirements, as of March 2016

| Project Name: | Prime Contractor: | Targeted Worker Goal (40%) | Apprentice Worker Goal (20%) | Disadvantaged Worker Goal (10%) | * Percentage of Disadvantaged Worker Participation that are in the Criminal Justice System Category |
|---|---|---|---|---|---|
| Crenshaw/LAX Transit Corridor | Walsh/Shea Corridor Constructors | 58.72% | 18.27% | 11.54% | 40.10% |
| Regional Connector Transit Corridor | Regional Connector Constructors, JV | 59.67% | 19.17% | 8.57% | 48.06% |
| Westside Subway Extension Project, Section 1 – Design Build | Skanska-Traylor-Shea, JV | 70.03% | 11.97% | 8.30% | 76.19% |
| Metro Red Line/Metro Orange Line (MRL/MOL) North Hollywood Station West Entrance | Skanska | 60.79% | 23.67% | 19.45% | 90.74% |
| Universal City Pedestrian Bridge | Griffith Company | 38.73% | 28.06% | 10.49% | 66.02% |
| Westside Extension Project Advanced Utility Relocation (La Cienega Station) | Bubalo Construction | 68.10% | 21.81% | 24.12% | 26.26% |
| Metro Blue Line Pedestrian and Swing Gates | Icon-West | 61.38% | 37.74% | 0.00% | 0.00% |
| Division 16 Southwestern Yard | Hensel Phelps/Herzog, JV | 1.54% | 11.35% | 0.00% | 0.00% |

In summary, of the eight active construction projects for this reporting period, six Contractors are exceeding the 40% Targeted Worker goal, four contractors are exceeding the 20% Apprentice Worker goal and four contractors are achieving the10% Disadvantaged Worker goal.

*Percentage of Disadvantaged Worker Participation that have had involvement with the Criminal Justice System Category

Part of Metro's PLA/CCP workforce requirement is the utilization of Disadvantaged workers on projects. One of the nine criteria for a disadvantaged worker is "having a criminal record or other involvement with the criminal justice system". The data shown in the table above is the percentage of Disadvantaged Workers (based on hours worked) that have criminal records or involvement with the criminal justice system and were given the opportunity to work in Metro's PLA/CCP projects.

**Currently Active Contracts**

Crenshaw/LAX Transit Corridor Project
Prime: Walsh/Shea Corridor Constructors

The Crenshaw/LAX Transit Corridor project contractor has completed 53.92% of the estimated construction work hours for this project. The contractor is currently exceeding the Targeted Worker goal at 58.72%, Disadvantaged Worker goal at 11.54% and the minority participation percentage goals, but not meeting the 20% Apprentice Worker goal at 18.27% and the 6.90% Female Participation goal at 2.99%. The attainment for the 20% Apprentice Worker goal is based on total apprentice-able hours. The contractor has submitted a plan and schedule indicating that the apprentice goal for this project should be achieved in the middle of 2017. Staff will continue to work closely with the contractor towards meeting all worker goals for this project.

Regional Connector Transit Corridor
Prime: Regional Connector Constructors, Joint Venture

The Regional Connector Transit Corridor Project is underway and only 5.77% of the estimated construction work hours for this project have been performed. The contractor is currently exceeding the Targeted Worker goal at 59.67%, and the minority participation percentage goals, but not meeting the 20% Apprentice Worker goal at 19.17%, the 10% Disadvantaged Worker goal at 8.57% and the 6.90% Female Participation goal at 3.08%. The attainment for the 20% Apprentice Worker goal is based on total apprentice-able hours. This project is still in the design-phase with limited construction activities and attainments are in line with the contractor's submitted Employment Hiring Plan which states compliance with the PLA/CCP workforce goals will be met in mid-2016.

Westside Subway Extension Project, Section 1 Design-Build
Prime: Skanska-Traylor-Shea, a Joint Venture (STS)

The Westside Subway Extension Project, Section 1 is underway and only 2.56% of the estimated construction work hours for this project has been performed. The contractor is currently exceeding the Targeted Worker goal at 70.03% and the minority participation percentage goals, but not meeting the 20% Apprentice Worker goal at 11.97%, the 10% Disadvantaged Worker goal at 8.30% and the 6.90% Female Participation goal at 5.71%. The attainment for the 20% Apprentice Worker is based on total apprentice-able hours. This project is in the early stage of the design-phase with limited construction and the attainments are in line with the contractor's submitted Employment Hiring Plan which states compliance with the PLA/CCP workforce goals will be met in Mid-2018.

Metro Red Line/Metro Orange Line (MRL/MOL) North Hollywood Station West Entrance
Prime: Skanska

The Metro Red Line/Metro Orange Line (MRL/MOL) North Hollywood Station West Entrance project contractor has completed 75.15% of the estimated construction work hours on this project. The contractor is currently exceeding the Targeted Worker goal at 60.79%, Apprentice Worker Goal at 23.67%, Disadvantaged Worker goal at 19.45%, Female Participation goal at 9.73% and the minority participation percentage goals. The attainment for the 20% Apprentice Worker goal is based on total apprentice-able hours. For this reporting cycle, the Contractor has met all PLA/CCP workforce provisions.

Universal City Pedestrian Bridge
Prime: Griffith Company

The Universal City Pedestrian Bridge project contractor has completed 99.12% of the estimated construction work hours on this project. The contractor is currently exceeding the Apprentice Worker goal at 28.06%, Disadvantaged Worker goal at 10.49% and the minority participation percentage goals, but not meeting the 40% Targeted Worker goal at 38.73% and the 6.90% Female Participation goal at 1.96%. The attainment for the 20% Apprentice Worker goal is based on total apprentice-able hours. Metro has issued several Notices of Non-Compliance to the Contractor for low attainment on the Targeted Worker goal and will keep the Board updated on the Contractor’s progress.

Westside Extension Project Advanced Utility Relocation (La Cienega)
Prime: Bubalo Construction

The Westside Extension Project Advanced Utility Relocation project contractor has completed 79.98% of the estimated construction work hours on this project. The contractor is currently exceeding the Targeted Worker goal at 68.10%, Apprentice Worker goal at 21.81%, Disadvantaged Worker goal at 24.12%, and the minority participation percentage goals, but not meeting the 6.90% Female Participation goal at 0.69%. The attainment for the 20% Apprentice Worker goal is based on total apprentice-able hours. For this reporting cycle, the Contractor has met the 40/20/10 PLA/CCP workforce provisions.

Metro Blue Line Pedestrian & Swing Gates
Prime: Icon-West

The Metro Blue Line Pedestrian & Swing Gates Project is underway and only 2.11% of the estimated construction work hours for this project has been performed. The contractor is currently exceeding the Targeted Worker goal at 61.38%, Apprentice Worker goal at 37.74% and the minority participation percentage goals, but not meeting the 10% Disadvantaged Worker goal at 0.00% and the 6.90% Female Participation goal at 0.00%. The attainment for the 20% Apprentice Worker is based on total apprentice-able hours. This project is in the early stage of construction with limited hours reported. Contractor submitted an Employment Hiring Plan which states compliance with the PLA/CCP workforce goals will be met by mid-point of construction activities.

Division 16 - Southwestern Yard
Prime: Hensel Phelps/Herzog, J.V.

The Division 16 Southwestern Yard Project is underway and only 0.20% of the estimated construction work hours for this project has been performed. This project is in the early stage of the design-phase with limited construction, and as such, is not representative of the typical trades and hours that will be performed on the project. The contractor is currently exceeding the minority participation percentage goals, but not meeting the 40% Targeted Worker goal at 1.54%, the 20% Apprentice Worker goal at 11.35%, the 10% Disadvantaged Worker goal at 0.00% and the 6.90% Female Participation goal at 0.00%. The attainment for the 20% Apprentice Worker is based on total apprentice-able hours. The Contractor submitted an Employment Hiring Plan which states compliance with the PLA/CCP workforce goals will be met by mid-2017. This contract falls under the U.S. DOT's Local Hire Pilot Program.

## Completed Contracts

| Completed Projects: | Prime Contractor: | Targeted Worker Goal (40%) | Apprentice Worker Goal (20%) | Disadvantaged Worker Goal (10%) | *Percentage of Disadvantaged Workers that are in the Criminal Justice System Category |
|---|---|---|---|---|---|
| Crenshaw Advanced Utility Relocation Project | Metro Builders | 61.41% | 13.84% | 21.08% | 2.90% |
| Westside Subway Extension Advanced Utility Relocation | Metro Builders | 67.47% | 11.12% | 11.08% | 0.00% |
| Westside Subway Exploratory Shaft | Innovative Construction Solutions | 50.88% | 75.05% | 11.23% | 96.23% |
| Regional Connector Transit Corridor Adv. Utility Relocation | Pulice Construction | 51.61% | 21.37% | 22.83% | 28.39% |
| CNG Emergency Generator Division 7 & 8 | Taft Electric | 46.42% | 25.51% | 39.08% | 39.48% |
| Division 13 CNG Fueling Facility, Design/Build/Operate | Clean Energy | 67.54% | 20.17% | 60.72% | 49.48% |
| Metro Blue Line Stations Refurbishments | S.J. Amoroso | 56.01% | 26.10% | 13.62% | 28.03% |
| Westside Extension Project Advanced Utility Relocation (Fairfax Station) | WA Rasic | 63.27% | 20.61% | 19.90% | 9.24% |
| Metro Rail Security Kiosks | Icon-West | 45.90% | 27.06% | 20.17% | 100.00% |

<u>Crenshaw Advanced Utility Relocation Project</u>
<u>Prime: Metro Builders</u>

The Crenshaw Advanced Utility Relocation project is 100% complete as of September 2014. Final reporting shows the Targeted Worker attainment at 61.41%, Disadvantaged Worker attainment at 21.08% and the minority participation percentage goals were attained, but the contractor did not meet the 20% Apprentice Worker goal at 13.84% and the 6.90% Female Participation goal at 0.52%. The attainment for the 20% Apprentice worker goal is based on total apprentice-able hours. Metro staff met with the contractor in January 2015, and executed a special assessment for not meeting the apprentice goal for this project. The contractor complied with Metro's special assessment and this issue is closed.

<u>Westside Subway Extension Advanced Utility Relocation</u>
<u>Prime: Metro Builders</u>

The Westside Subway Extension Advanced Utility Relocation project is 100% complete as of October 2014. Final reporting shows the Targeted Worker attainment at 67.47%, Disadvantaged Worker attainment at 11.08%, Female Participation attainment at 7.48% and the minority participation percentage goals were attained, but the contractor did not meet the 20% Apprentice Worker goal at 11.12%. The attainment for the 20% Apprentice worker goal is based on total apprentice-able hours. Metro staff met with the contractor in January 2015, and executed a special assessment for not meeting the apprentice goal for this project. The contractor complied with Metro's special assessment and this issue is closed.

Westside Subway Exploratory Shaft
Prime: Innovative Construction Solutions (ICS)

The Westside Subway Extension Exploratory Shaft project is 100% complete as of October 2014. Final reporting shows the Targeted Worker attainment at 50.88%, Apprentice Worker attainment at 75.05%, Disadvantaged Worker attainment at 11.23% and the minority participation percentage goals were attained, but the contractor did not meet the 6.90% Female Participation goal at 0.42%. The attainment for the 20% Apprentice worker goal is based on total apprentice-able hours. No labor grievances occurred on this project.

Regional Connector Transit Corridor Advanced Utilities Relocation
Prime: Pulice Construction

The Regional Connector Transit Corridor Advanced Utilities Relocation project was terminated for convenience in April 2015 and is now closed. Final reporting shows the Targeted Worker attainment at 51.61%, Apprentice Worker attainment at 21.37%, Disadvantaged Worker attainment at 22.83% and the minority participation percentage goals were attained, but the contractor did not meet the 6.90% Female Participation goal at 2.57%.

CNG Emergency Generator Division 7 and 8
Prime: Taft Electric

The CNG Emergency Generator Division 7 and 8 project is 100% complete as of May 2015. Final reporting shows the Targeted Worker attainment at 46.42%, Apprentice Worker attainment at 25.51%, Disadvantaged Worker attainment at 39.08% and the minority percentage goals were attained, but the contractor did not meet the 6.90% Female Participation goal at 4.68%. The attainment for the 20% Apprentice worker goal is based on total apprentice-able hours. No labor grievances occurred on this project.

Division 13 CNG Fueling Facility, Design/Build/Operate
Prime: Clean Energy

The Division 13 CNG Fueling Facility, Design/Build/Operate project contractor is 100% complete as of June 2015. Final reporting shows the Targeted Worker attainment at 67.54%, Apprentice Worker attainment at 20.17%, Disadvantaged Worker attainment at 60.72% and the minority percentage goals were attained, but the contractor did not meet the 6.90% Female Participation goal at 1.69%. The attainment for the 20% Apprentice worker goal is based on total apprentice-able hours. No labor grievances occurred on this project.

Metro Blue Line Station Refurbishments
Prime: S.J. Amoroso

The Metro Blue Line Station Refurbishments project contractor is 100% complete as of August 2015. Final reporting shows the Targeted Worker attainment at 56.01%, Apprentice Worker attainment at 26.10%, Disadvantaged Worker attainment at 13.62% and the minority percentage goals were attained, but the contractor did not meet the 6.90% Female Participation goal at 0.48%. The attainment for the 20% Apprentice Worker goal is based on total apprentice-able hours.

Westside Subway Extension Advanced Utility Relocation (Fairfax Station)
Prime: W.A. Rasic

The Westside Subway Extension Advanced Utility Relocation - Fairfax Station project is 100% complete as of December 2015. Final reporting shows the Targeted Worker attainment at 63.27%, Apprentice Worker attainment at 20.61%, Disadvantaged Worker attainment at 19.90% and the minority percentage goals were attained, but the contractor did not meet the 6.90% Female Participation goal at 2.78%. The attainment for the 20% Apprentice Worker goal is based on total apprentice-able hours.

Metro Rail Security Kiosks
Prime: Icon-West

The Metro Rail Security Kiosks project contractor is 100% complete as of March 2016. Final reporting shows the Targeted Worker attainment at 45.90%, Apprentice Worker attainment at 27.06%, Disadvantaged Worker attainment at 20.17% and the minority percentage goals were attained, but the contractor did not meet the 6.90% Female Participation goal at 0.00%. The attainment for the 20% Apprentice Worker goal is based on total apprentice-able hours.

**FEMALE UTILIZATION UPDATE:**

Below is a female utilization participation report on Metro's PLA/CCP projects to track progress. The chart shows the number of cumulative female workers on active PLA/CCP projects within the last three months as requested at the July 2015 Committee meeting.

| Project Name: | Prime Contractor: | No. of Female Workers January 2016 | No. of Female Workers February 2016 | No. of Female Workers March 2016 |
|---|---|---|---|---|
| Crenshaw/LAX Transit Corridor | Walsh/Shea Corridor Constructors | 69 | 71 | 71 |
| Regional Connector Transit Corridor | Regional Connector Constructors, JV | 8 | 11 | 12 |
| Westside Subway Extension Project, Section 1 | Skanska-Traylor-Shea, JV | 5 | 10 | 12 |
| Metro Red Line/Metro Orange Line (MRL/MOL) North Hollywood Station West Entrance | Skanska | 4 | 4 | 4 |
| Universal City Pedestrian Bridge | Griffith Company | 5 | 5 | 5 |
| Westside Extension Project Advanced Utility Relocation (La Cienega Station) | Bubalo Construction | 4 | 4 | 4 |
| Metro Blue Line Pedestrian and Swing Gates | Icon-West | Project has not started | Project has not started | 1 |
| Division 16 – Southwestern Yard | Hensel Phelps/Herzog, JV | Project has not started | Project has not started | 0 |

In an effort to increase female participation within Metro's PLA/CCP projects which has averaged 3.21% for all active PLA/CCP projects, staff has coordinated or is currently coordinating the following efforts:

- Metro convened a "Women Build METRO LA" Committee to develop strategies and outreach activities to highlight the need for women in the construction industry, with emphasis on the opportunities and assistance that is available. The taskforce membership includes: LA/OC Building Construction Trade Council Executive Secretary, Ron Miller, IBEW Vice President Jane Templin, UNITEHERE President, Maria Elena Durazo, Women in Non-Traditional Employment Roles (WINTER), Metro's DEOD Executive Director, Office of the Speaker of the Assembly, Prime Contractors, Jobs Coordinators and others.
  In March, the Committee hosted 70 females on a Union Apprenticeship Training Center tour. The next event scheduled is an Orientation and 6-Week Boot Camp for females, to take place at Los Angeles Trade Technical College, beginning in Mid-June. Staff is enlisting Prime

Contractors to participate so that the training can potentially result in immediate sponsorship in to the Union for certain candidates.

- Metro staff has convened a taskforce to develop an Apprenticeship Prep training program in conjunction with Los Angeles Trade Technical College. The taskforce consist of the Vice President of Academic Affairs & Workforce Development of Los Angeles Trade Technical College, Prime Contractor representatives and Metro staff.
    - Prime Contractors have committed to assist in providing employment opportunities to graduates of this Apprenticeship Prep training program.
    - The 1st Apprenticeship Prep training program is scheduled to take place during the Summer of 2016.
    - Recruitment for this training program will be focused primarily on women with demonstrated interest in starting a career in the construction and/or transportation industry.

Staff will provide updates as these programs are further developed.

**PILOT LOCAL HIRE INITIATIVE**

In March 2015, the U.S. Department of Transportation (DOT) announced an initiative to permit, on an experimental basis, Federal Highway Administration (FHWA) and Federal Transit Administration (FTA) recipients and sub- recipients the ability to utilize previously disallowed local/geographic-based labor hiring preferences and economic-based labor hiring preferences on Construction and Rolling Stock projects. This initiative was carried out as a pilot program for a period of 1 year and has been extended through March 6, 2017 under the FHWA and FTA's existing Authorities. The Pilot initiative may be implemented immediately on federally funded Construction projects.

As of this quarterly reporting period, there is currently one construction project that is active and subject to the Pilot Local Hire Initiative;

- C0991 Division 16 - Southwestern Yard (contract amount of $172mil)

This requirement was included in the solicitation for the Westside Purple Line Extension Section 2 design build contract. Staff is continually monitoring federally funded PLA/CCP covered projects awarded during the "Pilot Local Hire Initiative" implementation period and will report any additional projects subject to the Local Hire Initiative Program to the Board.
Metro received DOT and FTA approval on September 30, 2015 to use Metro's Local Employment Program (LEP) on four (4) Rolling Stock procurements. The Local Employment Program may only be applied on an experimental basis on Metro's New Heavy Rail Car, New Bus Buy and two Rail Car Overhaul solicitations. The FTA's approval also contained specific conditions that limit the Local Employment Program to a voluntary program. This means that the program cannot be used to determine responsiveness to the solicitation or as a basis for award. Nonetheless, the Local Employment Program will provide Proposers with an opportunity to receive up to 5% additional preferential scoring points if new jobs are committed as part of their proposal.

The FTA's approval also modified the definition of how Metro may define its geographical preference for new jobs and facility improvements for the New Heavy Rail Car and New Bus RFPs. For those two procurements the definition of local employment will include anywhere in the State of California. For the two rail vehicle overhaul projects the FTA will allow Metro to limit the geographical preference for new job creation to Los Angeles County.

Proposers that volunteer to participate in Metro's Local Employment Program and who commit to new job local job creation must also commit to hiring a minimum of 10% of their new work force as Disadvantaged Workers. The targeted hiring requirement will be a condition for obtaining any preferential scoring points.

Currently, the New Heavy Rail Car, A650 Red Line Car Overhaul and P2000 light Rail Car Overhaul RFPs are in black-out. The A650 Red Line Overhaul is scheduled to be presented to the Board for contract award in September 2016, and the New Heavy Rail Car and P2000 Overhaul are scheduled for November 2016.

The New Bus Buy RFP for 600 40' buses will be issued in the summer 2016. Additionally, Staff is planning on consolidating the 40' bus buy with a new requirement for 400 60' buses into a single RFP. Staff intends to request approval from FTA to implement the pilot local jobs program on a single 40' and 60' bus procurement. This request is consistent with the U.S. Department of Transportation's recent announcement to extend the Local Hire Pilot Program through September 2016.

Staff will continue to report on the "Pilot Local Hire Initiative" on a quarterly basis as part of the Project Labor Agreement/Construction Careers Program quarterly updates.

## OUTREACH

In efforts to attain the highest percentages of Targeted, Apprentice and Disadvantaged Workers on PLA/CCP projects, and to keep the community informed of opportunities, the contractors and DEOD participated and/or coordinated the following outreach efforts during this reporting period:

- Daily/Weekly/bi-weekly meetings with outreach team, contractor, elected staffers and/or community representatives.
- Continuous collaboration with Five Keys Charter to promote Metro's PLA/CCP workforce initiatives within Los Angeles County Jail system.
- Women Build METRO LA event held on March 23, 2015.
- Participated in the Resource Fair sponsored by Council District 8 & 10, held on March 12, 2016.
- Women Build METRO LA - Union Training Center Tours held on March 23, 2016.
- Participated in the 6th Annual Spring into Summer Hiring Spree Event sponsored by Supervisor Mark Ridley-Thomas held on April 13, 2016.
- Construction Careers Awareness Day in partnership with LAUSD and Los Angeles Trade Tech College (LATTC) held on April 14, 2016.

## NEXT STEPS

Staff will continue to monitor and assist Contractors with hiring efforts, and will enforce compliance as necessary.

## ATTACHMENTS

A. PLA/CCP Report, Data Through March 2016

Prepared by: Miguel Cabral, Executive Officer
Diversity & Economic Opportunity (213) 922-2232

Victor Ramirez, Interim Executive Officer, Vendor & Contract Management, (213) 922-1059

Keith Compton, Director, PLA/CCP
Compliance & Administration, (213) 922-2406

Miriam Long, Manager, Strategic Business & Construction Career Resources, (213) 922-7249

Reviewed by: Ivan Page, Interim Executive Director,
Vendor/Contract Management (213) 922-6383

Phillip A. Washington
Chief Executive Officer

# Project Labor Agreement (PLA) / Construction Careers Policy (CCP) Update

## Report Data Through
## March 2016 Reporting Period

Metro

# Crenshaw/LAX Transit Corridor Project

## PLA Targeted Worker Attainment: Prime: Walsh/Shea

### Report Data Through March 2016

| No. of Work Hours* | Targeted Economically Disadvantaged Worker Utilization (%) Goal: 40% | Apprentice Utilization (%) Goal: 20% | Disadvantaged Worker Utilization (%) Goal: 10% |
|---|---|---|---|
| 1,617,512.57 | 58.72% | 18.27% Based on Total Apprenticeable Work Hours | 11.54% |

**Percentage Project Complete Based on Worker Hours: 53.92% (rounded)**

## Executive Order 11246 Demographic Summary

| No. of Work Hours* | African American Utilization | Asian/Pacific Islander Utilization | Caucasian Utilization | Hispanic Utilization | Native American Utilization | Other/Declined to state | Minority Utilization Goal: 28.3% (rounded) | Female Utilization Goal: 6.9% |
|---|---|---|---|---|---|---|---|---|
| 1,617,512.57 | 15.05% | 1.10% | 23.48% | 55.56% | 1.16% | 3.64% | 72.87% | 2.99% |

Metro

*Cumulative Hours Through End of Noted Reporting Period – as Reported by Prime Contractor. Data subject to change to reflect updates or audits.

# Regional Connector Transit Corridor Project
# PLA Targeted Worker Attainment: Prime: R.C.C., Joint Venture

## Report Data Through March 2015

| No. of Work Hours* | Targeted Economically Disadvantaged Worker Utilization (%) Goal: 40% | Apprentice Utilization (%) Goal: 20% | Disadvantaged Worker Utilization (%) Goal: 10% |
|---|---|---|---|
| 189,627.25 | 59.67% | 19.17% Based on Total Apprenticeable Work Hours | 8.57% |

**Percentage Project Complete Based on Worker Hours: 5.77% (rounded)**

# Executive Order 11246 Demographic Summary

| No. of Work Hours* | African American Utilization | Asian/Pacific Islander Utilization | Caucasian Utilization | Hispanic Utilization | Native American Utilization | Other/Declined to state | Minority Utilization Goal: 28.3% (rounded) | Female Utilization Goal: 6.9% |
|---|---|---|---|---|---|---|---|---|
| 189,627.25 | 7.19% | 0.42% | 26.36% | 63.52% | 0.82% | 1.70% | 71.95% | 3.08% |

Metro

*Cumulative Hours Through End of Noted Reporting Period – as Reported by Prime Contractor. Data subject to change to reflect updates or audits.

# Westside Subway Extension Project, Section 1 – D/B

# PLA Targeted Worker Attainment: Prime: S.T.S., Joint Venture

## Report Data Through March 2016

| No. of Work Hours* | Targeted Economically Disadvantaged Worker Utilization (%) Goal: 40% | Apprentice Utilization (%) Goal: 20% | Disadvantaged Worker Utilization (%) Goal: 10% |
|---|---|---|---|
| 83,502.07 | 70.03% | 11.97% Based on Total Apprenticeable Work Hours | 8.30% |

Percentage Project Complete Based on Worker Hours: 2.56% (rounded)

# Executive Order 11246 Demographic Summary

| No. of Work Hours* | African American Utilization | Asian/Pacific Islander Utilization | Caucasian Utilization | Hispanic Utilization | Native American Utilization | Other/Declined to state | Minority Utilization Goal: 28.3% (rounded) | Female Utilization Goal: 6.9% |
|---|---|---|---|---|---|---|---|---|
| 83,502.07 | 10.80% | 0.38% | 21.55% | 62.06% | 0.29% | 4.92% | 73.53% | 5.71% |

Metro

*Cumulative Hours Through End of Noted Reporting Period – as Reported by Prime Contractor. Data subject to change to reflect updates or audits.

# MRL/MOL North Hollywood Station West Entrance

## PLA Targeted Worker Attainment: Prime: Skanska

### Report Data Through March 2016

| No. of Work Hours* | Targeted Economically Disadvantaged Worker Utilization (%) Goal: 40% | Apprentice Utilization (%) Goal: 20% | Disadvantaged Worker Utilization (%) Goal: 10% |
|---|---|---|---|
| 55,613.25 | 60.79% | 23.67% Based on Total Apprenticeable Work Hours | 19.45% |

**Percentage Project Complete Based on Worker Hours: 75.15% (rounded)**

## Executive Order 11246 Demographic Summary

| No. of Work Hours* | African American Utilization | Asian/Pacific Islander Utilization | Caucasian Utilization | Hispanic Utilization | Native American Utilization | Other/Declined to state | Minority Utilization Goal: 28.3% (rounded) | Female Utilization Goal: 6.9% |
|---|---|---|---|---|---|---|---|---|
| 55,613.25 | 13.09% | 0.03% | 27.70% | 53.54% | 1.52% | 4.12% | 68.18% | 9.73% |

Metro

*Cumulative Hours Through End of Noted Reporting Period – as Reported by Prime Contractor. Data subject to change to reflect updates or audits.

# Universal City Pedestrian Bridge
# PLA Targeted Worker Attainment: Prime: Griffith Company

## Report Data Through March 2016

| No. of Work Hours* | Targeted Economically Disadvantaged Worker Utilization (%) Goal: 40% | Apprentice Utilization (%) Goal: 20% | Disadvantaged Worker Utilization (%) Goal: 10% |
|---|---|---|---|
| 85,239.85 | 38.73% | 28.06% Based on total Apprenticeable Work hours | 10.49% |

**Percentage Project Complete Based on Worker Hours: 99.12% (rounded)**

# Executive Order 11246 Demographic Summary

| No. of Work Hours* | African American Utilization | Asian/Pacific Islander Utilization | Caucasian Utilization | Hispanic Utilization | Native American Utilization | Other/Declined to state | Minority Utilization Goal: 28.3% (rounded) | Female Utilization Goal: 6.9% |
|---|---|---|---|---|---|---|---|---|
| 85,239.85 | 9.45% | 4.26% | 21.92% | 60.75% | 0.74% | 2.87% | 75.20% | 1.96% |

Metro

*Cumulative Hours Through End of Noted Reporting Period – as Reported by Prime Contractor. Data subject to change to reflect updates or audits.

# Westside Extension Project AUR (La Cienega Station)

# PLA Targeted Worker Attainment: Prime: Bubalo Construction

## Report Data Through March 2016

| No. of Work Hours* | Targeted Economically Disadvantaged Worker Utilization (%) Goal: 40% | Apprentice Utilization (%) Goal: 20% | Disadvantaged Worker Utilization (%) Goal: 10% |
|---|---|---|---|
| 35,990.95 | 68.10% | 21.81% Based on Total Apprenticeable Work Hours | 24.12% |

Percentage Project Complete Based on Worker Hours: 79.98% (rounded)

# Executive Order 11246 Demographic Summary

| No. of Work Hours* | African American Utilization | Asian/Pacific Islander Utilization | Caucasian Utilization | Hispanic Utilization | Native American Utilization | Other/Declined to state | Minority Utilization Goal: 28.3% (rounded) | Female Utilization Goal: 6.9% |
|---|---|---|---|---|---|---|---|---|
| 35,990.95 | 4.93% | 0.00% | 7.54% | 87.53% | 0.00% | 0.00% | 92.46% | 0.69% |

Metro

*Cumulative Hours Through End of Noted Reporting Period – as Reported by Prime Contractor. Data subject to change to reflect updates or audits.

# Metro Blue Line Pedestrian & Swing Gates

# PLA Targeted Worker Attainment: Prime: Icon-West

## Report Data Through March 2016

| No. of Work Hours* | Targeted Economically Disadvantaged Worker Utilization (%) Goal: 40% | Apprentice Utilization (%) Goal: 20% | Disadvantaged Worker Utilization (%) Goal: 10% |
|---|---|---|---|
| 479.00 | 61.38% | 37.74% Based on Total Apprenticeable Work Hours | 0.00% |

**Percentage Project Complete Based on Worker Hours: 2.11% (rounded)**

# Executive Order 11246 Demographic Summary

| No. of Work Hours* | African American Utilization | Asian/Pacific Islander Utilization | Caucasian Utilization | Hispanic Utilization | Native American Utilization | Other/Declined to state | Minority Utilization Goal: 28.3% (rounded) | Female Utilization Goal: 6.9% |
|---|---|---|---|---|---|---|---|---|
| 479.00 | 4.18% | 0.00% | 28.60% | 67.22% | 0.00% | 0.00% | 71.40% | 5.01% |

Metro

*Cumulative Hours Through End of Noted Reporting Period – as Reported by Prime Contractor. Data subject to change to reflect updates or audits.

# Division 16: Southwestern Yard
# PLA Targeted Worker Attainment: Prime: Hensel Phelps/Herzog, JV

## Report Data Through March 2016

| No. of Work Hours* | Targeted Economically Disadvantaged Worker Utilization (%) Goal: 40% | Apprentice Utilization (%) Goal: 20% | Disadvantaged Worker Utilization (%) Goal: 10% |
|---|---|---|---|
| 714.00 | 1.54% | 11.35% Based on Total Apprenticeable Work Hours | 0.00% |

Percentage Project Complete Based on Worker Hours: 0.20% (rounded)

## Executive Order 11246 Demographic Summary

| No. of Work Hours* | African American Utilization | Asian/Pacific Islander Utilization | Caucasian Utilization | Hispanic Utilization | Native American Utilization | Other/Declined to state | Minority Utilization Goal: 28.3% (rounded) | Female Utilization Goal: 6.9% |
|---|---|---|---|---|---|---|---|---|
| 714.00 | 2.17% | 0.00% | 24.16% | 43.28% | 0.00% | 30.39% | 45.45% | 0.00% |

Metro

*Cumulative Hours Through End of Noted Reporting Period – as Reported by Prime Contractor. Data subject to change to reflect updates or audits.

# Crenshaw/LAX Advanced Utilities Relocations

## PLA Targeted Worker Attainment: Prime: Metrobuilders

### Report Data Through Oct 31, 2014 (FINAL)

| No. of Work Hours | Targeted Economically Disadvantaged Worker Utilization (%) Goal: 40% | Apprentice Utilization (%) Goal: 20% | Disadvantaged Worker Utilization (%) Goal: 10% |
|---|---|---|---|
| 61,708.26* | 61.41% | | 21.08% |
| 43,277.52** | | 13.84% | |

Percentage Project Complete Based on Worker Hours: 100%

## Executive Order 11246 Demographic Summary

| No. of Work Hours* | African American Utilization | Asian/Pacific Islander Utilization | Caucasian Utilization | Hispanic Utilization | Native American Utilization | Other/Declined to state | Minority Utilization Goal: 28.3% (rounded) | Female Utilization Goal: 6.9% |
|---|---|---|---|---|---|---|---|---|
| 61,708.26 | 11.66% | 0.01% | 22.02% | 66.29% | 0.01% | 0.00% | 77.97% | 0.52% |

Metro

* Total Cumulative Project Hours as Reported by Prime Contractor.
** Total Apprenticeable Cumulative Hours as Reported by Prime Contractor.

# Westside Subway Extension Advanced Utilities

## PLA Targeted Worker Attainment: Prime: Metrobuilders

### Report Data Through November 2014 (FINAL)

| No. of Work Hours* | Targeted Economically Disadvantaged Worker Utilization (%) Goal: 40% | Apprentice Utilization (%) Goal: 20% | Disadvantaged Worker Utilization (%) Goal: 10% |
|---|---|---|---|
| 37,731.76 | 67.47% | 11.12% | 11.08% |

Percentage Project Complete Based on Worker Hours: 100%

## Executive Order 11246 Demographic Summary

| No. of Work Hours* | African American Utilization | Asian/Pacific Islander Utilization | Caucasian Utilization | Hispanic Utilization | Native American Utilization | Other/Declined to state | Minority Utilization Goal: 28.3% (rounded) | Female Utilization Goal: 6.9% |
|---|---|---|---|---|---|---|---|---|
| 37,731.76 | 3.92% | 0.00% | 12.76% | 76.87% | 0.00% | 6.45% | 80.79% | 7.48% |

Metro

*Cumulative Hours Through End of Noted Reporting Period – as Reported by Prime Contractor. Data subject to change to reflect updates or audits.

# Westside Subway Extension Exploratory Shaft

## PLA Targeted Worker Attainment: Prime: Innovative Constructive Solutions

### Report Data Through October 2014 (FINAL)

| No. of Work Hours | Targeted Economically Disadvantaged Worker Utilization (%) Goal: 40% | Apprentice Utilization (%) Goal: 20% | Disadvantaged Worker Utilization (%) Goal: 10% |
|---|---|---|---|
| *18,049.25 | 50.88% | | 11.23% |
| **238.50 | | 75.05% | |

Percentage Project Complete Based on Worker Hours: 100%

## Executive Order 11246 Demographic Summary

| No. of Work Hours* | African American Utilization | Asian/Pacific Islander Utilization | Caucasian Utilization | Hispanic Utilization | Native American Utilization | Other/Declined to state | Minority Utilization Goal: 28.3% (rounded) | Female Utilization Goal: 6.9% |
|---|---|---|---|---|---|---|---|---|
| 18,049.25 | 11.40% | 0.00% | 22.71% | 33.18% | 1.19% | 31.52% | 45.77% | 0.42% |

Metro

* Total Cumulative Project Hours as Reported by Prime Contractor.

** Total Apprenticeable Cumulative Hours as Reported by Prime Contractor.

# Regional Connector Advanced Utility Relocations
# PLA Targeted Worker Attainment: Prime: Pulice

## Report Data Through May 2015 (FINAL)

| No. of Work Hours* | Targeted Economically Disadvantaged Worker Utilization (%) Goal: 40% | Apprentice Utilization (%) Goal: 20% | Disadvantaged Worker Utilization (%) Goal: 10% |
|---|---|---|---|
| 58,903.00 | 51.61% | 21.37% Contractor Reported Based on Total Work Hours | 22.83% |

Percentage Project Complete Based on Worker Hours: 100.00% (rounded)

## Executive Order 11246 Demographic Summary

| No. of Work Hours* | African American Utilization | Asian/Pacific Islander Utilization | Caucasian Utilization | Hispanic Utilization | Native American Utilization | Other/Declined to state | Minority Utilization Goal: 28.3% (rounded) | Female Utilization Goal: 6.9% |
|---|---|---|---|---|---|---|---|---|
| 58,903.00 | 1.36% | 0.41% | 17.43% | 80.30% | 0.00% | 0.50% | 82.07% | 2.57% |

Metro

*Cumulative Hours Through End of Noted Reporting Period – as Reported by Prime Contractor. Data subject to change to reflect updates or audits.

# CNG Emergency Generator Division 7 and 8

## PLA Targeted Worker Attainment: Prime: Taft Electric Company

### Report Data Through May 2015 (FINAL)

| No. of Work Hours* | Targeted Economically Disadvantaged Worker Utilization (%) Goal: 40% | Apprentice Utilization (%) Goal: 20% | Disadvantaged Worker Utilization (%) Goal: 10% |
|---|---|---|---|
| 3,289.50 | 46.42% | 25.51% Based on Total Apprenticeable Work Hours | 39.08% |

Percentage Project Complete Based on Worker Hours: 100.00% (rounded)

## Executive Order 11246 Demographic Summary

| No. of Work Hours* | African American Utilization | Asian/Pacific Islander Utilization | Caucasian Utilization | Hispanic Utilization | Native American Utilization | Other/Declined to state | Minority Utilization Goal: 28.3% (rounded) | Female Utilization Goal: 6.9% |
|---|---|---|---|---|---|---|---|---|
| 3,289.50 | 14.47% | 1.92% | 38.21% | 45.40% | 0.00% | 0.00% | 61.79% | 4.68% |

Metro

*Cumulative Hours Through End of Noted Reporting Period – as Reported by Prime Contractor. Data subject to change to reflect updates or audits.

# Division 13 CNG Fueling Facility, Design/Build/Operate PLA Targeted Worker Attainment: Prime: Clean Energy

## Report Data Through June 2015 (FINAL)

| No. of Work Hours* | Targeted Economically Disadvantaged Worker Utilization (%) Goal: 40% | Apprentice Utilization (%) Goal: 20% | Disadvantaged Worker Utilization (%) Goal: 10% |
|---|---|---|---|
| 11,496.00 | 67.54% | 20.17% Based on Total Apprenticeable Work Hours | 60.72% |

Percentage Project Complete Based on Worker Hours: 100.00% (rounded)

## Executive Order 11246 Demographic Summary

| No. of Work Hours* | African American Utilization | Asian/Pacific Islander Utilization | Caucasian Utilization | Hispanic Utilization | Native American Utilization | Other/Declined to state | Minority Utilization Goal: 28.3% (rounded) | Female Utilization Goal: 6.9% |
|---|---|---|---|---|---|---|---|---|
| 11,496.00 | 31.21% | 3.03% | 26.54% | 39.23% | 0.00% | 0.00% | 73.47% | 1.69% |

Metro

*Cumulative Hours Through End of Noted Reporting Period – as Reported by Prime Contractor. Data subject to change to reflect updates or audits.

# Metro Blue Line Station Refurbishments
# PLA Targeted Worker Attainment: Prime: S.J. Amoroso

## Report Data Through June 2015 (FINAL)

| No. of Work Hours* | Targeted Economically Disadvantaged Worker Utilization (%) Goal: 40% | Apprentice Utilization (%) Goal: 20% | Disadvantaged Worker Utilization (%) Goal: 10% |
|---|---|---|---|
| 41,274.75 | 56.01% | 26.10% Based on Total Apprenticeable Work Hours | 13.62% |

Percentage Project Complete Based on Worker Hours: 100.00% (rounded)

## Executive Order 11246 Demographic Summary

| No. of Work Hours* | African American Utilization | Asian/Pacific Islander Utilization | Caucasian Utilization | Hispanic Utilization | Native American Utilization | Other/Declined to state | Minority Utilization Goal: 28.3% (rounded) | Female Utilization Goal: 6.9% |
|---|---|---|---|---|---|---|---|---|
| 41,274.75 | 16.59% | 1.55% | 20.72% | 61.14% | 0.00% | 0.00% | 79.28% | 0.48% |

Metro

*Cumulative Hours Through End of Noted Reporting Period – as Reported by Prime Contractor. Data subject to change to reflect updates or audits.

# Westside Subway Extension Project AUR (Fairfax Station)
# PLA Targeted Worker Attainment: Prime: W.A. Rasic

## Report Data Through December 2015 (FINAL)

| No. of Work Hours* | Targeted Economically Disadvantaged Worker Utilization (%) Goal: 40% | Apprentice Utilization (%) Goal: 20% | Disadvantaged Worker Utilization (%) Goal: 10% |
|---|---|---|---|
| 37,510.00 | 63.27% | 20.61% Based on Total Apprenticeable Work Hours | 19.90% |

Percentage Project Complete Based on Worker Hours: 100.00% (rounded)

## Executive Order 11246 Demographic Summary

| No. of Work Hours* | African American Utilization | Asian/Pacific Islander Utilization | Caucasian Utilization | Hispanic Utilization | Native American Utilization | Other/Declined to state | Minority Utilization Goal: 28.3% (rounded) | Female Utilization Goal: 6.9% |
|---|---|---|---|---|---|---|---|---|
| 37,510.00 | 9.44% | 0.01% | 13.39% | 77.08% | 0.00% | 0.09% | 86.53% | 2.78% |

Metro

*Cumulative Hours Through End of Noted Reporting Period – as Reported by Prime Contractor. Data subject to change to reflect updates or audits.

# Metro Rail Security Kiosks
# PLA Targeted Worker Attainment: Prime: Icon-West

## Report Data Through March 2016 (FINAL)

| No. of Work Hours* | Targeted Economically Disadvantaged Worker Utilization (%) Goal: 40% | Apprentice Utilization (%) Goal: 20% | Disadvantaged Worker Utilization (%) Goal: 10% |
|---|---|---|---|
| 7,281.75 | 45.90% | 27.06% Based on Total Apprenticeable Work Hours | 20.17% |

Percentage Project Complete Based on Worker Hours: 100.00% (rounded)

# Executive Order 11246 Demographic Summary

| No. of Work Hours* | African American Utilization | Asian/Pacific Islander Utilization | Caucasian Utilization | Hispanic Utilization | Native American Utilization | Other/Declined to state | Minority Utilization Goal: 28.3% (rounded) | Female Utilization Goal: 6.9% |
|---|---|---|---|---|---|---|---|---|
| 7,281.75 | 48.19% | 0.27% | 15.16% | 34.78% | 0.87% | 0.72% | 84.11% | 0.00% |

Metro

*Cumulative Hours Through End of Noted Reporting Period – as Reported by Prime Contractor. Data subject to change to reflect updates or audits.

Los Angeles County
Metropolitan Transportation
Authority
One Gateway Plaza
3rd Floor Board Room
Los Angeles, CA

**File #:** 2016-0315, **File Type:** Informational Report **Agenda Number:** 18

**PLANNING AND PROGRAMMING COMMITTEE**
**MAY 18, 2016**
**CONSTRUCTION COMMITTEE**
**MAY 19, 2016**

**SUBJECT: AIRPORT METRO CONNECTOR (OPERATION SHOVEL READY)**

**ACTION: RECEIVE AND FILE**

## RECOMMENDATION

RECEIVE AND FILE the **quarterly status report on the Airport Metro Connector** (AMC) including clarification on the project's target delivery date in response to the April 2016 Board Motion (Attachment A).

## ISSUE

This report provides an update on the following: (1) environmental review process; (2) architectural and engineering design services; (3) Crenshaw/LAX Transit Project design accommodations; and (4) project schedule and funding opportunities.

## DISCUSSION

Staff, in coordination with Los Angeles World Airports (LAWA), continues to advance development of the AMC 96th Street transit station. Over this past quarter, work continued on the preparation of the Draft Environmental Impact Report (EIR), conceptual station design, and accommodations as part of the Crenshaw/LAX Line Project to allow for future construction of the AMC station. Staff continues to explore additional funding options. LAWA continues its environmental clearance and design processes for the Los Angeles International Airport (LAX) Landside Access Modernization Program (LAMP), including the Automated People Mover (APM). LAWA's APM system includes six new stations with one of the stops located at the AMC transit station. Metro riders will be able to transfer to the APM system in order to reach the Central Terminal Area at LAX.

### Environmental Review Process

Staff continues to work with LAWA representatives to coordinate the respective environmental efforts for both the AMC transit station and LAMP program, which are on parallel schedules. LAWA provided Metro with existing and projected traffic data to help ensure that both separate and independent projects are fully synchronized. In addition to exchanging data, Metro staff continues to attend the bi-weekly multi-agency ground access technical coordination meetings led by LAWA with Caltrans, the Southern California Association of Governments (SCAG) and the Los Angeles Department of Transportation (LADOT) to discuss roadway concepts, freeway access, traffic modeling, and details of the LAX LAMP.

Architectural and Engineering Design Services

Work progresses on defining the station's program elements to help prepare site concepts depicting square footage and programming and building(s) footprint. Staff continues to work with LAWA on coordinating proposed project elements as well as coordinating on the station design guidelines as identified in the approved June 2014 Metro Board motion (Attachment B).

Crenshaw/LAX Design Accommodations

Staff is negotiating the final Design and Construction contract modification with Walsh-Shea Corridor Constructors for the AMC station accommodations and has issued a limited Notice to Proceed for the design of the track, guideway and systems accommodations. Design is substantially complete and released for construction. Staff is currently working with Walsh-Shea Corridor Contractors on the construction costs and anticipates seeking Metro Board approval for the contract modification in June 2016.

Schedule and Funding

In March 2015, based on further analysis and coordination with the LAWA, staff informed the Metro Board that the AMC station would open with LAWA's APM in calendar year 2023 (Fiscal Year 2024). There has been no change to this schedule, which is subject to additional funding being secured for the project. This project which is a regional project is scheduled for delivery in the first 15 years of the draft Potential Ballot Measure (PBM) Expenditure Plan currently under public review. The calendar year (Fiscal Year 2024) delivery date accelerates the project by five years from the 2028 date in the currently adopted Long Range Transportation Plan (LRTP). In addition to PBM funding, staff is pursuing other funding opportunities, including the State Transit and Intercity Rail Capital Program (TIRCP) Grant, Federal Transit Administration (FTA) Transportation Investment Generating Economic Recovery (TIGER VII) Discretionary Grant, the FTA Bus and Bus Facilities Discretionary Grant and the State Active Transportation Program.

## NEXT STEPS

Staff will continue to coordinate with LAWA on the station design. Staff anticipates releasing the Draft EIR in June 2016 for public comment and returning to the Board in the Fall for certification of the document. During this time period, discussions will continue with the FTA on the type of the federal environmental clearance needed for this project.

## ATTACHMENTS

Attachment A - April 28, 2016 Board Motion
Attachment B - June 2014 Board Motion

Prepared by: Meghna Khanna, Deputy Project Manager (213) 922-3931
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Phillip A. Washington
Chief Executive Officer

Los Angeles County
Metropolitan Transportation
Authority
One Gateway Plaza
3rd Floor Board Room
Los Angeles, CA

Metro

Metro

# Board Report

**File #:**2016-0339, **File Type:**Motion / Motion Response

Agenda Number:43

**REGULAR BOARD MEETING**
**APRIL 28, 2016**

**Motion by:**

**DIRECTOR KNABE**

April 28, 2016

## Airport Metro Connector

Measure R was passed in 2008, with over two-thirds support of voters in Los Angeles County, and funds a promised transit connection to Los Angeles International Airport (LAX). Today, almost eight years later, Metro is closer to making the rail connection to the airport a reality, and is contemplating a potential ballot measure for an additional half-cent sales tax that would include important funding to accelerate the planned rail connection to LAX. Throughout 2015 and into 2016-, Metro and Los Angeles World Airports (LAWA) have indicated to our Board that the project would be completed in mid-2023. LAWA appeared at the Board meeting in February and provided a presentation showing the LAWA automated people mover completed in 2023. However, the delivery date for the Airport Metro Connector project has been inexplicable pushed out to 2024-2026 in the proposed Expenditure Plan for the potential ballot measure, which is unacceptable.

**MOTION by Director Knabe** that the MTA Board instruct the CEO to report back to the Board during the May 2016 Board cycle with:

A. a quarterly report on the status of the Airport Connector project;

B. information on why the project's delivery date may be later than previously reported to the Board and identifying options for putting the project back on schedule for accelerated delivery; and

C. a recommendation based on staff's analysis.

June 26, 2014 Board Motion

**MTA Board Meeting** **Relating to Item 65**
**June 26, 2014**

**MOTION BY**
**MAYOR ERIC GARCETTI, COUNCILMEMBER MIKE BONIN, SUPERVISOR DON KNABE & SUPERVISOR MARK RIDLEY-THOMAS**

For decades, the biggest missing piece of the transportation puzzle in Los Angeles has been a quick, convenient, and viable option for the traveling public to connect to our airport using our mass transit system. Making that connection has been a high priority for all Angelenos, who clearly made their position known by overwhelmingly supporting the construction of a direct airport connection as part of Measure R.

Several criteria are essential in evaluating the various alternatives that have been proposed for the Airport Metro Connector including cost, travel time, and interoperability with the regional network. However, given the considerable importance that the transit riders have placed on a seamless and robust airport connection, the final project will be judged largely by its ability to deliver on one critical aspect: passenger convenience.

The desire to provide an exceptional passenger experience should guide the Metro Board in designing this project. This airport connection will only be as good as the passenger experience it delivers, and the ridership numbers will largely reflect our ability to anticipate, meet, and exceed the expectations of the traveling public.

Done right, Alternative A2 ($96^{th}$ Street Station) could be the airport rail connection that Angelenos have longed for. It would provide a direct rail connection that will not only help address the ground transportation challenges at LAX, but also continue to expand MTA's regional transportation network, and has the potential to provide a world-class passenger experience to the traveling public.

The $96^{th}$ Street Station can be the new "front door" to LAX for transit riders, and MTA and LAWA should work together and think imaginatively to meet and exceed the needs of the traveling public, and create a robust, visionary transit facility.

WE THEREFORE MOVE THAT the MTA Board of Directors adopt and direct the Chief Executive Officer to do the following:

1. Develop the 96th Street Station, in consultation with LAWA, using the following design guidelines:

    a. Enclosed facility

    b. Integrated APM/Light Rail station, minimizing walk distances

    c. Concourse areas

    d. LAX airline check-in with flight information boards

    e. Station restrooms

    f. Free public WiFi & device charging areas

    g. Private vehicle drop-off area, and taxi stand

    h. Pedestrian plaza with landscaping and street furniture

    i. Metro Bike Hub with parking, a bike repair stand and bike pump, showers, lockers, controlled access and 24-hour security cameras

    j. Retail (food/beverage and convenience)

    k. L.A. visitor info and LAX info kiosk

    l. Connectivity to Manchester Square and surrounding areas, including walkways

    m. At a minimum, LEED Silver certification

    n. Public art installation

    o. Other amenities for airport travelers, including currency exchange and bank/ATM machines

    p. Passenger safety

2. Report back at the September 2014 MTA Board meeting, in consultation with LAWA, with a review of baggage check amenities that are available at other transportation centers that serve major airports, including an assessment of the feasibility of offering baggage check at the proposed 96th Street Station.

3. Procure a qualified architectural firm to design the station as described under no. 1 above.

4. Provide quarterly updates, in coordination with LAWA staff, including, but not limited to, on the development of the 96th Street Station, the Intermodal Transportation Facility and Automated People Mover, of the following:

    a. Design

    b. Schedule

    c. Cost Estimates

5. Report back at the September 2014 MTA Board meeting with a conceptual and station design approach plan as described above, and provide quarterly updates on implementation progress thereafter; and

6. Instruct the CEO to work with LAWA and the Board of Airport Commissioners to obtain their written commitment to construct and operate an automated people mover connecting the airport's central terminal area to a planned Metro Rail Station, and to report back at next month's (July 2014) Planning and Programming and Construction Committees, and at Committees each month thereafter until this written commitment is obtained, in order to ensure that the light rail connection to LAX that was promised to the voters in Measure R becomes a reality.

Los Angeles County
Metropolitan Transportation
Authority
One Gateway Plaza
3rd Floor Board Room
Los Angeles, CA

Metro

# Board Report

**File #:** 2016-0363, **File Type:** Oral Report / Presentation **Agenda Number:** 19

**CONSTRUCTION COMMITTEE**
**May 19, 2016**

RECEIVE **Oral Report by the Program Management Executive Director.**

## DISCUSSION

RECEIVE **Oral Report by the Program Management Executive Director.**

## ATTACHMENTS

Attachment A - Program Management Executive Director's Report - May 2016
Attachment B - Project Status Sheets - May 2016

Prepared by:

- **Crenshaw/LAX -** Charles Beauvoir, Deputy Executive Officer, Project Mgmt., (213)299-3095
- **Regional Connector -** Girish Roy, Deputy Executive Officer, Project Mgmt., (213)893-7119
- **Westside Purple Line Ext 1 and 2-** Dennis Mori, EO Project Mgmt., (213)922-7238
- **I-405 -** Nazem Moussa, Deputy Executive Officer, Project Mgmt. (213)922-7221
- **Division 13 -** Timothy Lindholm, EO Project Engr., (213)922-7297
- **Patsaouras Plaza Busway Station -** Timothy Lindholm, EO Project Engr., (213)922-7297
- **MRL - MOL North Hollywood Station -** Timothy Lindholm, EO Project Engr., (213)922-7297
- **Universal Pedestrian Bridge -** Timothy Lindholm, EO Project Engr., (213)922-7297
- **Presentation -** Shannon Hanley, Senior Administrative Analyst, (213)922-1350

Reviewed by: Richard Clarke, Executive Director, Program Management, (213) 922-7557

# Program Management Executive Director's Report

## Project Status Report

Presented By
**Richard Clarke**
Executive Director,
Program Management

# PROJECT BUDGET & SCHEDULE STATUS SUMMARY CHART

| Project | Cost Performance | Schedule Performance | Comments |
|---|---|---|---|
| Crenshaw/LAX | OK | Possible problem | Need to conclude 96th Street Station accommodation time impact as well as other time extensions requests from contractor. |
| Westside Purple Line Extension-Section 1 | OK | OK | |
| Westside Purple Line Extension-Section 2 | OK | OK | |
| Regional Connector | Major issue | Major issue | Need to conclude schedule recovery negotiations. |
| 1-405 Sepulveda Pass improvements Project | Major issue | OK | Working through remaining items for Final Acceptance. Preparation for Claim 86 arbitration is ongoing. |
| Patsaouras Plaza | OK | OK | Budget revision approved by Board in March 2016. Utility relocations are scheduled to start May 2016 and foundation work will start in Summer 2016. |
| Division 13 | OK | OK | Project is 100% complete and open as of February 1, 2016. |
| Universal City Pedestrian Bridge | OK | OK | Construction substantially completed on April 7th, 2016. Punch List and close out work is in progress |
| MOL to MRL North Hollywood Connector | OK | OK | Construction is 70% complete. There are no significant issues on this project at this time. |

OK On target  Possible problem  Major issue

# CRENSHAW/LAX TRANSIT PROJECT

**OK BUDGET**

| | Current | Forecast |
|---|---|---|
| TOTAL COST | $2,058M | $2,058M |

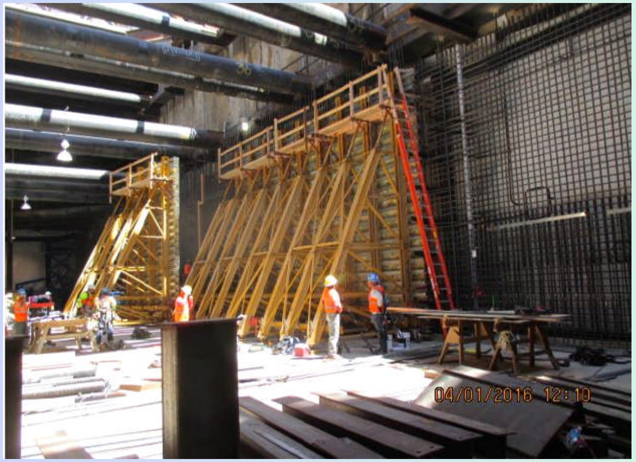
**SCHEDULE**

| | Current | Forecast |
|---|---|---|
| REVENUE OPERATION | Oct 2019 | Oct 2019 |

- Overall construction progress is 37.2% complete (excludes contractor mobilization costs).
- 96th Street Station Accommodation cost and schedule negotiations nearing completion.
- Tunneling from Expo/Crenshaw Station toward Leimert Park Station commenced in April.
- Park Mesa Heights construction commenced in April.
- Continued bridge falsework construction for Crenshaw Project tie-in with operating Green Line.
- Southwestern Yard construction to start in May.

Looking north from the TBM toward the trailing gear gantries

Expo/Crenshaw Station




Forming lower walls

# WESTSIDE PURPLE LINE – SECTION 1

OK **BUDGET**

| | Current | Forecast |
|---|---|---|
| **TOTAL COST*** | **$3,154M** | **$3,154M** |

* Includes Board approved LOP plus Planning and Finance costs.

OK **SCHEDULE**

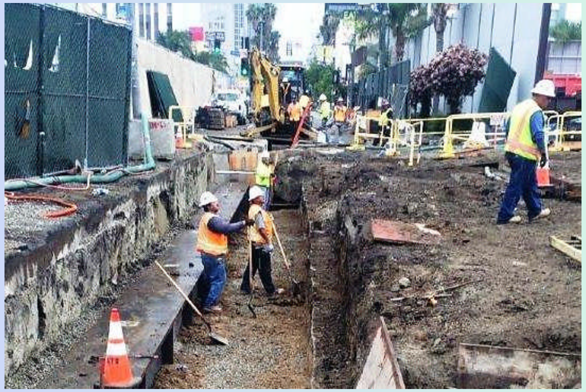
| | Current | Forecast |
|---|---|---|
| **REV. OPERATION** | **Nov 2023** | **Nov 2023** |

The Advanced Utility Relocations (AUR) work involving three contracts is 87% complete overall.

- Two of the three Advanced Utility Relocations Contracts have been completed on schedule.
- The LADWP power relocations at the Wilshire/Fairfax Station are on-going and are anticipated to complete by mid-September 2016. Southern California Edison (SCE) and City of Beverly Hills sewer, water and storm drain relocations continue. This is the last AUR contract and is on schedule to be completed in December 2016.

Tunnels, Stations, Trackwork and Systems Design-Build Contract

- Final Design for the Tunnels, three subway stations, trackwork, and systems is 85% complete overall.
- Pile installation at the Wilshire/La Brea Station is well underway to support the excavation at the launch site for the Tunnel Boring Machines.



Wilshire/La Brea Station – Preparation for Deck Beams

Electrical Metering Switchgear for Tunnel Operations

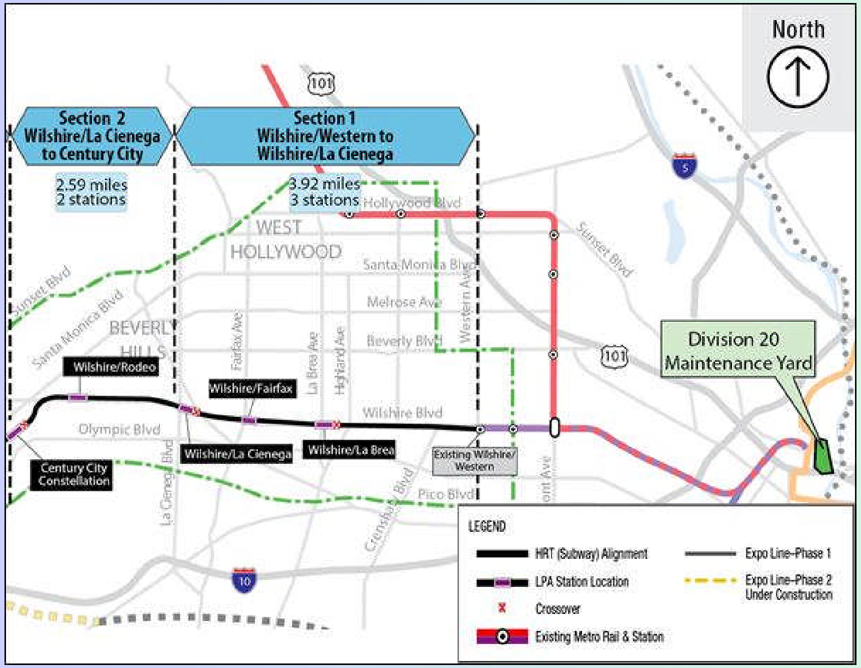
# WESTSIDE PURPLE LINE – SECTION 2

| OK **BUDGET** | Current | Forecast |
|---|---|---|
| **TOTAL COST** | **TBD** | **$2,467M** |

Life-of-Project Budget is yet to be adopted

| OK **SCHEDULE** | Current | Forecast |
|---|---|---|
| **REV. OPERATION** | **TBD** | **August 2025** |

- Contract C1120 – Design/Build Request for Qualifications/Request for Proposal was released on September 14, 2015.
- The three teams meeting the minimum requirements as a result of the RFQ were announced on December 4, 2015.
- Price proposals are due on June 1, 2016.
- FFGA anticipated approval August 2016.
- Contract award anticipated January 2017.



# REGIONAL CONNECTOR TRANSIT CORRIDOR

**BUDGET**

| | Current | Forecast |
|---|---|---|
| TOTAL COST | $1,599M | TBD |

* Includes Board approved LOP plus Planning and Finance costs.

**SCHEDULE**

| | Current | Forecast |
|---|---|---|
| REV. OPERATION | June 2021 | June 2021 |

- Overall Project Progress is 17.6%, Design Build (DB) Construction is 10.1% and DB Final Design is 90.1% complete.
- Station Excavation/Lagging/Bracing continued at 1st/Central station and reached 18 ft. below surface.
- Installed 77 piles representing 38% of total count at 2nd/Hope; grading and station excavation underway.
- All electrical ductbanks at 2nd/Broadway have been installed and are being transitioned into LADWP ownership.
- On the east side of Flower St., between 4th and 5th Sts., 50 Piles out of 90 have been installed and DWP approved the Water Tie-In Phasing Plan.
- Schedule recovery negotiations ongoing.

Excavation and tieback activities at 1st/Central Station

# I-405 SEPULVEDA PASS IMPROVEMENTS PROJECT

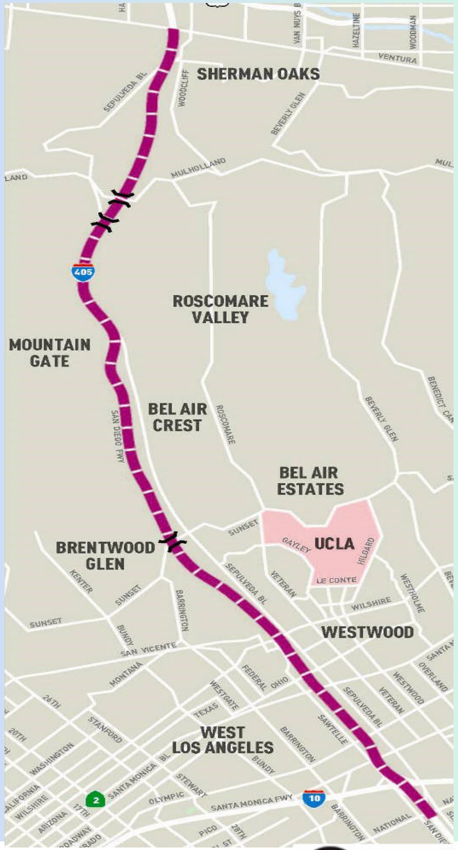
**BUDGET** (Major issue)

| | Current | Forecast |
|---|---|---|
| TOTAL COST | $1,308M | $1,308M |

**SCHEDULE** (OK)

| | Current | Forecast |
|---|---|---|
| SUBSTANTIAL COMPLETION | Sept 2015 | Sept 2015 |

- Contractor is working toward Final Completion
- Working through remaining items for Final Acceptance
- Preparation for Claim 86 arbitration is ongoing
- Forecast does not include non-merited Claim 86



# PATSAOURAS PLAZA BUSWAY STATION

**BUDGET** (OK)

| | Current | Forecast |
|---|---|---|
| TOTAL COST | $39.7M | $39.7M |

**SCHEDULE** (OK)

| | Current | Forecast |
|---|---|---|
| REV. OPERATION | Dec 2017 | Dec 2017 |

- Utility start of construction scheduled for May 2016, foundations in August 2016. Utility relocation must be completed by August 2016 to avoid conflicts with foundation construction.
- Work in progress includes final approval of 100% design package with Caltrans, receipt of Caltrans permits, ROW certifications, utility clearances, resolution of environmental issues with Caltrans, and exemptions to start construction.
- Board approved revised LOP budget in March 2016.
- Project completion scheduled for Winter 2017.

# DIVISION 13 BUS O&M FACILITY

**OK — BUDGET**

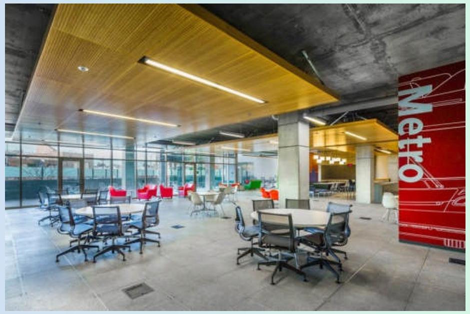
| | Current | Forecast |
|---|---|---|
| TOTAL COST | $120M | $120M |

**OK — SCHEDULE**

| | Current | Forecast |
|---|---|---|
| REV. OPERATION | Feb 2016 | Feb 2016 |

- Project is 100% complete and open as of February 1, 2016.
- Current activities include final punch list completion and close out of the contract with McCarthy.
- Project has been nominated as a finalist for 2016 Transit Project of the Year for the California Transportation Foundation awards, the International Interior Design Association Calibre Design Awards, and the Building Design & Construction magazine awards.



# UNIVERSAL PEDESTRIAN BRIDGE

| OK BUDGET | Current | Forecast |
|---|---|---|
| TOTAL COST | $29.6M | $29.6M |

| OK SCHEDULE | Current | Forecast |
|---|---|---|
| REV. OPERATION | April 2016 | April 2016 |

- Bridge was opened to public on April 7, 2016 to coincide with the opening of Harry Potter attraction by NBCUniversal
- Punch List items and close out process started

# MRL-MOL N. HOLLYWOOD STATION WEST ENTRANCE

| OK BUDGET | Current | Forecast |
|---|---|---|
| TOTAL COST | $23M | $23M |

| OK SCHEDULE | Current | Forecast |
|---|---|---|
| REV. OPERATION | Jul 2016 | Jul 2016 |

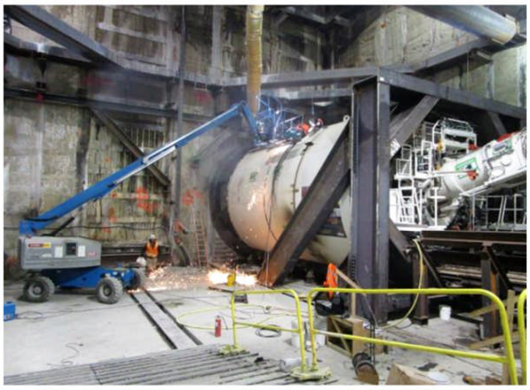
- Construction 70% complete
- Targeted completion by June 2016
- Mural Installation at new location completed
- Escalator and Elevators installation in progress
- Floor Tiles, Roof and Canopy work in progress
- TVM and Fare-gates installation to start


# Project Status Sheets-Crenshaw/LAX

**LOCATION: Crenshaw Blvd at Exposition to Green Line**
**DESIGN/CONSULTANT: Hatch Mott**

**CONSTRUCTION MANAGEMENT CONSULTANT: Stantec**
**CONTRACTOR: Walsh-Shea Corridor Constructors (WSCC)**

**PROJECT PHOTO: Preparing for start of tunneling at Expo/Crenshaw Station in April.**



**WORK COMPLETED PAST MONTH:**

- Design-builder continues final design.
- Continued construction efforts for UG#1 near LAX airport runways
- Continued Falsework construction at the Green Line tie-in.
- Continued superstructure construction for Century bridge.
- Continued offsite tunnel segment production.
- Continued abutment wall installation at I-405 bridge.
- Completed superstructure work for the La Brea bridge.
- Continued pot holing in advance of starting work at Park Mesa area.
- Continued soil excavation at Leimert Park Station.
- Completed soil excavation at MLK Station.
- TBM setup continued at Expo/Crenshaw Station.
- Continued real estate acquisitions with emphasis on remaining partial-takes and temporary construction easements.
- Southwestern Yard design-builder continued final design.

**EXPENDITURE STATUS**
**($ In Millions)**

| ACTIVITIES | CURRENT BUDGET | EXPENDED AMOUNT | PERCENT EXPENDED |
|---|---|---|---|
| **DESIGN** | $ 136.7 | $ 117.7 | 86.1% |
| **RIGHT-OF-WAY** | $ 127.4 | $ 112.3 | 88.1% |
| **CONSTRUCTION** | $ 1,353.1 | $ 517.0 | 38.2% |
| **OTHER** | $ 440.8 | $ 140.7 | 31.9% |
| TOTAL | $ 2,058.0 | $ 887.7 | 43.1% |

Note: cost expended as of April 2, 2016.

**AREAS OF CONCERN**

- Design-builder's ability to mitigate schedule delays.
- Timely review of WSCC's design submittals by City of Los Angeles.
- 96th street station cost and schedule potential impacts.

**SCHEDULE ASSESSMENT**

| MAJOR SCHEDULE ACTIVITIES | PRIOR PLAN | CURRENT PLAN | VARIANCE WEEKS |
|---|---|---|---|
| **Environmental** | | | |
| FEIS/FEIR | Sep-11 | Sep-11 | Complete |
| Record of Decision | Dec-11 | Dec-11 | Complete |
| **Design** | | | |
| Preliminary Engineering | Nov-11 | Nov-11 | Complete |
| Final Design | Sep-15 | Jun-16 | 9.4 months behind |
| **Right-of-Way** | | | |
| Full-take parcels available | Jan-15 | Jan-15 | Complete |
| Part-take and TCE parcels | Sep-15 | May-16 | 7.5 months behind |
| **Construction** | | | |
| D-B Notice to Proceed | Sep-13 | Sep-13 | Complete |
| D-B Substantial Complete | Oct-18 | Apr-19 | 5.7 months behind |
| Revenue Service Date | Oct-19 | Oct-19 | On schedule* |

The D-B Substantial Complete prior plan was modified by a 35-day concurrent delay contract modification in March 2015.

*Note: Current Revenue Service Date includes a significant reduction in contingency.

| ROW ACQUISITION | PLAN | ACQUIRED | REMAINING |
|---|---|---|---|
| FULL TAKES | 37 | 35 | 2 |
| PARTIAL TAKES | 27 | 23 | 4 |
| TEMPORARY EASEMENTS | 15 | 12 | 3 |
| **TOTAL PARCELS** | 79 | 70 | 9 |

**CRITICAL ACTIVITIES / 3 MONTH LOOK AHEAD**

- Launch TBM mining south bound tunnel at Expo/Crenshaw Station.
- Complete excavation at Leimert Park Station.
- Commence invert concrete placement at MLK Station.
- Commence work on Park Mesa area.
- Southwestern Yard design-builder to commence construction in May.

# Project Status Sheets-Westside Purple Line, Seg 1

| | |
|---|---|
| **LOCATION:** Los Angeles / Beverly Hills | **CONSTRUCTION MANAGEMENT CONSULTANT:** WEST, a Joint Venture |
| **DESIGN CONSULTANT:** Parsons / Brinckerhoff | **CONTRACTOR:** Skanska, Traylor and Shea, a Joint Venture |

**Slurry Backfill of Utility Relocations**

**WORK COMPLETED PAST MONTH**

- C1045 Wilshire/Western AFC began
- C1045 Wilshire/La Brea AFC began
- C1045 Wilshire/Fairfax 100% design underway
- C1045 Tunnel 100% design review by Metro
- C1045 Systems/Trackwork 85% design review by Metro
- C1045 Temporary TBM power substation switch gear in place
- C1045 Utility relocation continues
- C1045 Wilshire/La Brea pile delivery and north side installation continues
- C1056 Storm Drain - Wilshire between La Cienega and Hamilton
- C1045 Wilshire/Western demolition complete

**EXPENDITURE STATUS**
**($ In Millions)**

| ACTIVITIES | CURRENT BUDGET | EXPENDED AMOUNT | PERCENT EXPENDED |
|---|---|---|---|
| **DESIGN** | $159.2 | $120.7 | 75.8% |
| **RIGHT-OF-WAY** | $175.6 | $124.1 | 70.7% |
| **CONSTRUCTION** | $1,740.3 | $378.9 | 21.8% |
| **OTHER** | $1,079.3 | $98.5 | 9.1% |
| TOTAL | $3,154.4 | $722.2 | 22.9% |

Current Budget includes Environmental/Planning and Finance Costs.

**SCHEDULE ASSESSMENT**

| MAJOR SCHEDULE ACTIVITIES | PRIOR PLAN | CURRENT PLAN | VARIANCE WEEKS |
|---|---|---|---|
| **Environmental** | | | |
| FEIS / FEIR | N/A | 05/31/12 | Complete |
| | | | |
| **Design** | | | |
| PE Notice to Proceed | N/A | 01/12/11 | Complete |
| Final Design complete | 03/22/17 | 03/22/17 | 0 |
| **Right-of-Way** | | | |
| All parcels available* | 12/31/15 | 12/31/15 | 0 |
| **Construction - Main Design / Build Contract** | | | |
| Notice to Proceed | 01/12/15 | 01/12/15 | Complete |
| Construction complete | 11/08/23 | 11/08/23 | 0 |

*Parcels related to the main D/B Contract C1045

AREAS OF CONCERN

| ROW ACQUISITION | PLAN | AVAILABLE | REMAINING |
|---|---|---|---|
| PERMANENT PARCELS | 15 | 14 | 1 |
| TEMPORARY PARCELS | 4 | 4 | 0 |
| **TOTAL PARCELS** | 19 | 18 | 1 |

**CRITICAL ACTIVITIES / 3 MONTH LOOKAHEAD**

- C1045 Dewatering wells installation
- C1045 Removal of Wilshire/La Brea south yard tar sump
- C1045 Wilshire/La Brea Station north side pile installation completes
- C1045 Deck panels fabrication
- C1056 Wilshire/La Cienega AUR: Power relocation work continuing
- C1045 Wilshire/La Brea south side pile installation begins
- C1045 Temporary tunnel ventilation design submittals
- C1045 Wilshire/La Cienega 85% design submittal
- C1045 Wilshire/La Brea AFC submittal
- C1045 Wilshire/Western AFC submittal
- C1045 Tunnel 100% design submittal

# Project Status Sheets-Regional Connector

**LOCATION:** Downtown Los Angeles

**DESIGN CONSULTANT:** Connector Partnership JV

**CONSTRUCTION MANAGEMENT CONSULTANT:** ARCADIS

**CONTRACTOR: Regional Connector Constructors, Joint Venture**

**Opening of Little Tokyo Station**

**WORK/ACTIVITY COMPLETED PAST MONTH**

- Final Design 90.1%, DB construction10.1% complete
- 100% DU10 Traction Power Design, 100% Design Floating Slab Track Design, DU02 AFC Design for Flower St. Cut and Cover, 100% SOE Design Packages, and 85% DU11 Train Control Design for all stations
- Bus Bridge # 1 and Shoofly Testing; Gold Line trains were operational starting Sunday, March 20, 2016
- Pile trenching for the Wye at 1st/Alameda
- Pile installation for 1st St guideway
- 2nd Place Bridge Demolition
- Installation of trench drain at Hope site exit of 3rd/Flower
- Video assessment of Zanja No. 8-R on Flower between 5th and 6th Sts.

**EXPENDITURE STATUS**
**($ In Millions)**

| ACTIVITIES | CURRENT BUDGET | EXPENDED AMOUNT | PERCENT EXPENDED |
|---|---|---|---|
| DESIGN | $126.6 | $112.2 | 88.6% |
| RIGHT-OF-WAY | $110.5 | $68.7 | 62.2% |
| CONSTRUCTION | $1,079.3 | $269.0 | 24.9% |
| OTHER | $282.6 | $82.1 | 29.1% |
| TOTAL | $1,598.9 | $532.0 | 33.3% |

Current Budget reflects Board approved Life-of-Project Budget and includes Finance Charges.
Note: Expended amount is through 02/29/2016.

**SCHEDULE ASSESSMENT**

| MAJOR SCHEDULE ACTIVITIES | PRIOR PERIOD | CURRENT PLAN | VARIANCE WEEKS |
|---|---|---|---|
| **Environmental** | | | |
| FEIS / FEIR | N/A | 04/26/12 | Complete |
| SEIS Flower St. | N/A | 12/18/15 | Complete |
| **Design** | | | |
| PE Notice to Proceed | N/A | 01/04/11 | Complete |
| Final Design complete | 08/22/16 | 09/22/16 | 4 |
| Note: Completion of systems design is now projected for end of September 2016. No adverse impact to the overall schedule will result from this delay. | | | |
| **Right-of-Way** | | | |
| All parcels available | 06/01/16 | 08/15/18 | 26 |
| Note: ROW dates are adjusted to reflect the latest D/B Contractor's coordinated need Dates. Duco Yard need date is in August 2018. | | | |
| **Construction - Design / Build Contract** | | | |
| Notice to Proceed | 07/07/14 | 07/07/14 | Complete |
| Construction complete | 03/20/21 | 03/26/21 | 1 |
| Revenue Service Date | 06/02/21 | 06/08/21* | 1 |

Note : * The project is reflecting an approximate five-month delay to the RSD due to differing site conditions related to underground utilities.

**AREAS OF CONCERN**

- Schedule mitigation measures are being implemented across the alignment to address continuing and new delays precipitated by utility relocations.

**CRITICAL ACTIVITIES / 3 MONTH LOOK AHEAD**

- 100% design packages for all three stations and systems and review of the AFC for SOE design packages
- Pile installation for the Wye at 1st/Alameda
- Pile and tie-back installation, and station excavation at 1st/Central
- 6", 8", 12" and 16" water line construction activities at 1st/Alameda
- Start TBM SOE
- Store TBM at a storage site
- Decking at 1st/Alameda
- Electrical duct bank installation at 2nd/Broadway
- SOE Pile installation at 2nd/Hope
- Permeation grouting at 2nd St.
- Resolve Fire Life Safety (FLS) issues including emergency ventilation design and egress

| ROW ACQUISITION | PLAN | CERTIFIED | ACQUIRED | REMAINING |
|---|---|---|---|---|
| PERMANENT PARCELS | 5 | 5 | 4 | 1 |
| TEMPORARY PARCELS | 29 | 16 | 14 | 2 |
| TOTAL PARCELS | 34 | 21 | 18 | 3 |

Los Angeles County
Metropolitan Transportation
Authority
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3rd Floor Board Room
Los Angeles, CA

**File #:** 2016-0334, **File Type:** Contract **Agenda Number:** 20.

**CONSTRUCTION COMMITTEE**
**MAY 19, 2016**

**SUBJECT: REGIONAL CONNECTOR TRANSIT CORRIDOR PROJECT**

**ACTION: AUTHORIZE THE CHIEF EXECUTIVE OFFICER (CEO) TO EXECUTE CONTRACT MODIFICATION**

## RECOMMENDATION

AUTHORIZE the CEO to execute Contract Modification No. 24 to Contract No. E0119 with the **Connector Partnership Joint Venture (CPJV) Inc. to continue providing Design Support Services during Construction through FY17 for the Regional Connector Transit Corridor Project** (Project), in the amount of $5,565,000 increasing the total contract value from $62,742,374 to $68,307,374. This action does not increase Life of Project Budget.

## ISSUE

Metro's Project Management staff requires continuation of services to provide Design Support Services during Construction to review the design-builder's final design and ensure compliance with Metro's technical requirements, and other technical services during construction. Execution of the recommended Contract Modification No. 24 will provide continuity of the design support services during the final design phase and construction of the Project, as well as continued third-party coordination with the City, County, stakeholders and property owners.

The recommended Board action will provide sufficient contract funding for CPJV services through June 30, 2017. Future work will be funded on a year-to-year basis. This approach will result in more accurate budgeting for each year, while providing better control over consultant services.

## DISCUSSION

On October 28, 2010, the Board authorized the CEO to negotiate and execute Contract E0119, Advanced Conceptual Engineering (ACE) and Preliminary Engineering (PE) for the Regional Connector Transit Corridor Project, with an initial not-to-exceed amount of $21,500,000, and options for Design Support during Construction and System Activation Support. The executed contract is a cost-plus fixed fee contract with provisions for Board approval of the contract value every fiscal year by Contract Modification. Accordingly, this report requests approval of annual funding for FY17.

The ACE phase (Phase I) encompassed all design activities and products (including all necessary data collection, coordination, and design studies) to fully document environmental impacts, respond to comments from FTA in the Administrative Draft EIS/EIR, and to develop a detailed cost estimate sufficient for advancement to later stages of project delivery. The PE phase (Phase II) established the design of the basic structural, mechanical, electrical, communication systems, trackwork, automatic train control, traction power, overhead contact system, fare collection, and other systemwide interfaces. At the completion of PE, CPJV prepared contract documents for the design/build contracting delivery method.

The Board approved the project definition for the Regional Connector Transit Corridor Project on April 26, 2012. As a result of CPJV's work on the Project, Metro received a Record of Decision from the Federal Transit Administration (FTA) on June 29, 2012, and the Full Funding Grant Agreement (FFGA) on February 20, 2014.

In 2015, in accordance with CPJV's scope of work for Phase III, the Board authorized the CEO to exercise Contract Modification No. 22 for CPJV to continue to provide design support services during construction of the Regional Connector Transit Corridor.

## DETERMINATION OF SAFETY IMPACT

This Board action will not have an impact on established safety standards for Metro's construction projects.

## FINANCIAL IMPACT

Funds are requested through the FY17 Proposed budget for this action under Project 860228 - Regional Connector Transit Corridor in Cost Center 8510 (Construction Project Management), in Account 50316 (Professional and Technical Services). Since this is a multi-year project, the Executive Director of Program Management and the Project Manager will be accountable for budgeting costs for future years.

Board approval of the recommendation does not impact the life of project budget for the Regional Connector Transit Corridor Project.

### Impact to Budget

The sources of funds are Federal 5309 New Starts and TIFIA Loan Proceeds. These funds are designated for the Regional Connector Transit Corridor Project and do not have an impact to operations. This Project is not eligible for Propositions A and C funding due to the proposed tunneling element of the Project.

## ALTERNATIVES CONSIDERED

The Board could decide not to approve the recommended Contract Modification. This is not recommended because there are major elements of design support services work that are required to support this design-build project, and Metro does not currently have sufficient staff with the required expertise to ensure a timely review of the design-build contractor's Final Design and to provide engineering support directly to Metro during construction. Since CPJV developed the technical requirements for the design-build contract, staff recommends that CPJV continue the design support services that are essential to successfully delivering the project on schedule and within budget.

## NEXT STEPS

After Board approval and execution of the contract modification, staff will direct the consultant to continue providing design support services for the Regional Connector Transit Corridor Project through FY17.

## ATTACHMENTS

Attachment A - Procurement Summary
Attachment B - Contract Modification Authority (CMA) Summary
Attachment C - DEOD Summary

Prepared by:

Girish Roy, Deputy Executive Officer, (213) 893-7119
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Joe O' Donnell, Director, Contract Administration, (213) 893-7113

Reviewed by:

Ivan Page, Interim Executive Director, Vendor/Contract Management, (213) 922-6383

Richard Clarke, Executive Director, Program Management
(213) 922-7557

Phillip A. Washington
Chief Executive Officer

ATTACHMENT A

## PROCUREMENT SUMMARY

## ADVANCED CONCEPTUAL ENGINEERING AND PRELIMINARY ENGINEERING FOR THE REGIONAL CONNECTOR TRANSIT CORRIDOR PROJECT / CONTRACTE0119 MODIFICATION NO. 24

| | | | | |
|---|---|---|---|---|
| **1.** | **Contract Number**: E0119 | | | |
| **2.** | **Contractor**: Connector Partnership Joint Venture (CPJV) | | | |
| **3.** | **Mod. Work Description**: Provide FY17 design support services during construction for Contract No. C0980 for the Regional Connector Transit Corridor Project. | | | |
| **4.** | **Contract Work Description**: Advanced Conceptual Engineering, Preliminary Engineering, and Design Support During Construction for the Regional Connector Transit Corridor Project | | | |
| **5.** | **The following data is current as of**: March 30, 2016 | | | |
| **6.** | **Contract Completion Status** | | **Financial Status** | |
| | | | | |
| | **Contract Awarded:** | 12/2/10 | **Contract Award Amount:** | $21,500,000 |
| | **Notice to Proceed (NTP):** | 12/3/10 | **Total of Modifications Approved:** | $41,242,374 |
| | **Original Complete Date:** | 3/2018 | **Pending Modifications (including this action):** | $5,565,000 |
| | **Current Est. Complete Date:** | 3/2020 | **Current Contract Value (with this action):** | $68,307,374 |
| | | | | |
| **7.** | **Contract Administrator**:<br>Joe O’Donnell | | **Telephone Number**:<br>213-922-7231 | |
| **8.** | **Project Manager**:<br>Girish Roy | | **Telephone Number**:<br>213-893-7119 | |

## A. Procurement Background

This Board Action is to approve Contract Modification No. 24 issued in support of Design Support during Construction for the Regional Connector Transit Corridor Project.

This Contract Modification will be processed in accordance with Metro’s Acquisition Policy and the contract type is a cost plus fixed fee.

Contract No. E0119 was awarded through an A&E (qualification-based) procurement process. On October 28, 2010, the Metro Board authorized the Chief Executive Officer to negotiate and award a cost-plus fixed fee contract (No. E0119), for Regional Connector Transit Corridor Advanced Conceptual Engineering/Preliminary Engineering to Connector Partnership Joint Venture, for an amount not to exceed $21.5 million to perform Phase I, Advanced Conceptual Engineering and Phase II, Preliminary Engineering.  On December 2, 2010, Metro awarded a contract for $21,500,000 for a period of 14 months.

Since that time, 23 modifications have been issued to implement additional scope tasks in support of the Regional Connector Transit Corridor Project.  Refer to Attachment B – Contract Modification/Change Order Log.  Staff anticipates that Connector Partnership Joint Venture services will be required through March 2020.

## B. Cost/Price Analysis

The recommended price has been determined to be fair and reasonable based upon fact-finding, clarifications, and cost analysis, taking into consideration an independent cost estimate (ICE), technical evaluation, and negotiations, pending a completed audit of the consultant's provisional indirect rates.  The most current fiscal year data was requested from the consultant, and is expected to be provided shortly. Upon receipt of this data, an audit request will be submitted to Metro's Management Audit Support Department, and any audit findings will result in an equitable adjustment to the Contract.  An audit of the contractsultant's indirect rates is required each year to establish final indirect rates for each year.

| Proposal Amount | Metro ICE | Negotiated Amount |
|---|---|---|
| $5,822,295 | $5,323,000 | $5,565,000 |

**ATTACHMENT B**

## CONTRACT MODIFICATION/CHANGE LOG

## ADVANCED CONCEPTUAL ENGINEERING AND PRELIMINARY ENGINEERING FOR THE REGIONAL CONNECTOR TRANSIT CORRIDOR PROJECT/E0119

| Mod. no. | Description | Status (approved or pending) | Date | Amount |
|---|---|---|---|---|
| 1 | Risk Management Support | Approved | 3/14/11 | $203,059 |
| 2 | Revisions to Technical Scope of Services | Approved | 7/29/11 | $0 |
| 3 | Additional Geotechnical Borings | Approved | 3/21/11 | $256,215 |
| 4 | Upgrade Division 20 Generator & Tie-In | Approved | 12/13/11 | $108,937 |
| 5 | Increased Level of Effort for Design Services | Approved | 12/13/11 | $444,742 |
| 6 | Increased Level of Cost Estimating | Approved | 12/13/11 | $299,241 |
| 7 | Additional Specification Preparation Efforts | Approved | 12/27/11 | $219,707 |
| 8 | Constructability Design Changes | Approved | 12/27/11 | $139,197 |
| 9 | Flower Street Landscape Design | Approved | 1/4/12 | $138,696 |
| 10 | No Cost Extension | Approved | 2/9/12 | $0 |
| 11 | Advanced Preliminary Engineering | Approved | 3/1/12 | $8,796,669 |
| 12 | 2nd & Broadway Second Entrance Design | Approved | 4/25/12 | $367,771 |
| 13 | Advanced Utility Final Design | Approved | 6/6/12 | $455,474 |
| 14 | Cost Savings Station Designs | Approved | 8/27/12 | $470,612 |
| 15 | No Cost APE Extension | Approved | 11/1/12 | $0 |
| 16 | Additional Geotechnical Services | Approved | 12/8/12 | $53,767 |
| 17 | Bid Period Services | Approved | 12/4/12 | $0 |
| 18 | No Cost APE Extension | Approved | 12/1/12 | $0 |
| 19 | Bid Period Services | Approved | 1/3/13 | $5,828,270 |
| 20 | Bid Period Services / Design Support Services During Construction (Phase III) | Approved | 7/1/13 | $7,852,815 |
| 21 | Design Support Services During Construction (FY15) | Approved | 7/1/14 | $7,323,608 |
| 22 | Design Support Services During Construction (FY16) | Approved | 7/31/15 | $8,283,594 |
| 23 | No Cost Extension | Approved | 6/30/15 | $0 |
| 24 | Design Support Services During Construction (FY15) | Pending | | $5,565,000 |
| | **Modification Total:** | | | **$46,807,374** |
| | **Original Contract:** | | | **$21,500,000** |
| | **Total:** | | | **$68,307,374** |

## DEOD SUMMARY

## ADVANCED CONCEPTUAL ENGINEERING AND PRELIMINARY ENGINEERING FOR THE REGIONAL CONNECTOR TRANSIT CORRIDOR PROJECT (E0119)

### A. Small Business Participation

The Connector Partnership, Joint Venture (CPJV) made a 35.01% Disadvantaged Business Enterprise Anticipated Level of Participation (DALP) commitment. The current DBE participation is 28.29%, a shortfall of 6.72%. The project is 86.39% complete. According to CPJV, they are not meeting their DBE commitment due to Metro generated schedule delays and scope changes, which reduced work for DBE firms. CPJV confirms they are actively seeking additional DBE participation to provide necessary support services. Nine (9) DBE firms were added to CPJV's team. CPJV confirmed they are committed to increase DBE utilization, and will continue to seek opportunities to add DBEs. It is not expected that CPJV will meet their 35.01% DBE commitment.

| | | | |
|---|---|---|---|
| **Small Business Commitment** | **DALP 35.01%** | **Small Business Participation** | **DBE 28.29%** |

| | DBE Subcontractors | Ethnicity | % Committed | Current Participation[1] |
|---|---|---|---|---|
| 1. | Barrio Planners | Hispanic American | 4.17% | 3.18% |
| 2. | BA, Inc | African American | 3.43% | 5.18% |
| 3. | Dakota Communications | African American | 1.67% | 0.80% |
| 4. | D'Leon Engineers | Hispanic American | 2.35% | 1.50% |
| 5. | E2 Consulting Engineers | Subcontinent Asian American | 1.68% | 3.16% |
| 6. | Intueor Consulting, Inc. | Asian Pacific American | 3.34% | 3.03% |
| 7. | LKG-CMC, Inc. | Caucasian Female | 1.19% | 2.71% |
| 8. | A Cone Zone | Caucasian Female | 3.51% | 0.26% |
| 9. | Advanced Technologies Lab[2] | Hispanic American | 0.00% | 0.04% |
| 10. | AP Engineering & Testing[2] | Asian Pacific American | 0.00% | 0.02% |
| 11. | C&L Drilling | Caucasian Female | 1.50% | 0.00% |
| 12. | Jet Drilling | Hispanic American | 2.71% | 0.19% |
| 13. | Martini Drilling[2] | Hispanic American | 0.00% | 0.03% |
| 14. | Tri-County Drilling[2] | Caucasian Female | 0.00% | 0.43% |
| 15. | Murakawa Communications | Asian Pacific American | 0.63% | 0.00% |

| | | | | |
|---|---|---|---|---|
| 16. | Ted Tokio Tanaka Architects | Asian Pacific American | 5.01% | 3.39% |
| 17. | Tierra West Advisors, Inc. | Asian Pacific American | 0.76% | 0.54% |
| 18. | Wagner Engineering & survey | Caucasian Female | 1.79% | 1.19% |
| 19. | Raw International, Inc. | African American | 1.02% | 1.23% |
| 20. | Roy Willis & Associates | African American | 0.25% | 0.02% |
| 21. | Universal Reprographics, Inc. | Caucasian Female | 0.00% | 0.76% |
| 22. | Kal Krishnan Consulting Services[2] | Subcontinent Asian American | 0.00% | 0.02% |
| 23. | Lenax Construction Services[2] | Caucasian Female | 0.00% | 0.36% |
| 24. | Sapphos Environmental, Inc.[2] | Hispanic American | 0.00% | 0.12% |
| 25. | Calvin R. Abe, Inc.[2] | African American | 0.00% | 0.02% |
| 26. | VCA Engineering, Inc.[2] | Caucasian Female | 0.00% | 0.11% |
| | | **Total** | **35.01%** | **28.29%** |

[1] *Current Participation = Total Actual amount Paid-to-Date to DBE firms ÷Total Actual Amount Paid-to-date to Prime.*

[2] *DBE Subcontractors added after contract award.*

## B. Living Wage and Service Contract Worker Retention Policy Applicability

The Living Wage and Service Contract Worker Retention Policy is not applicable to this modification.

## C. Prevailing Wage Applicability

Prevailing Wage requirements are applicable to this project. DEOD will monitor contractors' compliance with the State of California Department of Industrial Relations (DIR), California Labor Code, and, if federally funded, the U S Department of Labor (DOL) Davis Bacon and Related Acts (DBRA).Trades that may be covered include: surveying, potholing, field, soils and materials testing, building construction inspection and other support trades.

## D. Project Labor Agreement / Construction Careers Policy

Metro's PLA/CCP does not apply to this contract.

Los Angeles County
Metropolitan Transportation
Authority
One Gateway Plaza
3rd Floor Board Room
Los Angeles, CA

**File #:** 2016-0326, **File Type:** Agreement **Agenda Number:** 21.

**CONSTRUCTION COMMITTEE**
**MAY 19, 2016**

**SUBJECT: WESTSIDE PURPLE LINE EXTENSION SECTION 1 PROJECT**

**ACTION: AUTHORIZE THE CHIEF EXECUTIVE OFFICER (CEO) TO EXECUTE AN AMENDMENT TO AN EXISTING MEMORANDUM OF UNDERSTANDING**

## RECOMMENDATION

AUTHORIZE the Chief Executive Officer to execute Amendment No. 1 to the existing Memorandum of Understanding between **Metro and the Los Angeles County Museum of Natural History, including the Page Museum at the La Brea Tar Pits, for the preservation and storage of paleontological and archaeological resources associated with the Westside Purple Line Extension Section 1 Project**.

## ISSUE

Metro executed a Memorandum of Understanding (MOU) with the Los Angeles County Museum of Natural History (NHM) for the Westside Purple Line Extension Project (WPLE) in November 2011. The MOU stipulates the roles and responsibilities for encountering, protecting, recovering, preserving, transporting and curating paleontological and archeological resources. The MOU did not include roles and responsibilities for the final permanent storage of paleontological resources that were recovered as part of the WPLE. Amendment 1 of the MOU stipulates the roles and responsibilities for the final permanent storage of paleontological resources.

## DISCUSSION

The Wilshire/Fairfax Station for the WPLE is located in the vicinity of the La Brea Tar Pits. The La Brea Tar Pits contain one of the world's largest collections of Ice Age fossils, which are located in soil deposits beneath the ground surface. Metro and the NHM executed a MOU in November 2011 to protect, recover, preserve, transport and curate any paleontological and archeological resources that might be discovered while performing work in the vicinity of the La Brea Tar Pits. This MOU was developed in parallel with the Final Environmental Impact Statement/Environmental Impact Report (Final EIS/EIR) for the project, which was approved by the Metro Board of Directors in April 2012. The MOU did not include roles and responsibilities for the final permanent storage of paleontological resources, i.e. fossils, because the amount and type of storage would not be known until the excavation of the Wilshire/Fairfax Station is performed. While the final quantity of fossils is still not known at this time, Metro and the NHM agreed that it would be best to define roles and responsibilities for the final permanent storage of these resources prior to beginning the work. Metro and the NHM further agreed that that the roles and responsibilities for final permanent storage would be limited by the project budget and schedule per the Federal Funding Grant Agreement (FFGA). The roles and responsibilities for permanent storage are now included in Amendment 1.

## DETERMINATION OF SAFETY IMPACT

This Board action will not have an impact on established safety standards.

## FINANCIAL IMPACT

Funding for this action is within the Life-of-Project Budget that was approved by the Board in July 2014, under Project 865518-Westside Purple Line Extension Section 1 Project in Cost Center 8510 (Construction Project Management), and Account Number 53101 (Acquisition of Building and Structure). Since this is a multi-year project, the Executive Director of Program Management and the Westside Purple Line Extension Section 1 Project Manager will be responsible for budgeting in future years.

### Impact to Budget

The sources of funds for the recommended action are Federal 5309 New Starts, Transportation Infrastructure Finance and Innovation Act (TIFIA) Loan proceeds and Measure R 35%. These funds are designated for Westside Purple Line Extension Section 1 Project and do not have an impact to Operations. These funds were assumed in the Long Range Transportation Plan (LRTP) for the Westside Purple Line Extension Section 1 Project. This Project is not eligible for Propositions A and C funding due to the proposed tunneling element of the Project. No other funds were considered.

## ALTERNATIVES CONSIDERED

The Board may choose not to execute Amendment 1. However, the roles and responsibilities for final permanent storage of any paleontological and archeological resources that may be discovered would be undefined.

## NEXT STEPS

After Board approval, Metro and the NHM will perform work for the Westside Purple Line Extension Section 1 Project in accordance with the terms of the MOU and Amendment 1.

## ATTACHMENTS

Attachment A - Amendment 1 to the Memorandum of Understanding between Metro and the Los Angeles County Natural History Museum

Attachment B - Memorandum of Understanding between Metro and the Los Angeles County Natural History Museum (Appendix G of FEIS/FEIR: Memorandum of Understanding for Paleontological Resources).

Prepared by:

Scott McConnell, Director, Construction Management (323) 900-2115
James Cohen, Deputy Executive Officer, Program Management (323) 900-2114
Rick Wilson, Deputy Executive Officer, Program Control (213) 312-3108

Reviewed by:

Richard Clarke, Executive Director, Program Management (213) 922-7557

Phillip A. Washington
Chief Executive Officer

**AMENDMENT NO. 1**

**THIS AMENDMENT NUMBER 1 TO THE MEMORANDUM OF UNDERSTANDING** ("MOU") is entered into as of this ______day of __________________ by and between the Los Angeles County Metropolitan Transportation Authority ("Metro") and the Los Angeles County Museum of Natural History, including the Page Museum at the La Brea Tar Pits ("Museum") (collectively, "the Parties"), for the preservation of paleontological and archaeological resources associated with the Wilshire/Fairfax Station and other portions of the Purple Line Extension Project (Project) alignment within two miles of the Wilshire/Fairfax Station.

**BACKGROUND**

**WHEREAS**, Metro has the responsibility under Federal and State law to recover and preserve for future scientific and educational use paleontological, archaeological, and historical resources that may be impacted by the Purple Line Extension Project and associated records; and

**WHEREAS**, the Parties have previously signed (November 2nd, 2011) a Preliminary MOU governing the recently completed excavation of the Metro Exploratory Shaft near the Page Museum and also setting out the general framework for mutually beneficial Paleontological cooperation;

WHEREAS, the County of Los Angeles and the Los Angeles County Museum of Natural History Foundation (Foundation) entered into a long term operating and funding agreement dated July 12, 1994, as amended, authorizing the Foundation to perform a variety of functions for the museum and accept and expend funds for the museum;

**WHEREAS,** Metro required the principal paleontologist to prepare and submit a mitigation plan, subject to approval by Metro and Museum, to address monitoring, preservation and, recovery of any paleontological resources which shall be consistent with best practices guidelines for both field and laboratory work on project paleontological resources to meet state and federal laws and guidelines and Museum standards (Attachments 1 and 2).

**WHEREAS,** Metro has separately negotiated a contract that includes the cost of monitoring by the principal paleontologist and staff and removing fossils from the Fairfax Purple Line Station and transporting them to a site for processing:

**WHEREAS,** the Museum has made available Museum personnel to provide oversight for the qualified principal paleontologist's preparation of a mitigation plan, subject to approval by the Agency, to address monitoring, preservation and, recovery of paleontological resources. The mitigation plan is consistent with best practices guidelines for both field and laboratory work on project paleontological resources to meet state and federal laws and guidelines and Museum standards (Attachments 1, 2, and 4).

**NOW, THEREFORE**, in consideration of the terms, conditions, covenants and performances herein contained, and other consideration the receipt and sufficiency of which is hereby acknowledged, and with the intent to be legally bound hereby, the Parties agree to incorporate the above recitals into this MOU and further contract, promise and agree as follows:

1. **Metro's Duties and Obligations**:

a. Require the selected principal paleontologist to monitor all ground-disturbing activities where sub-surface soils are exposed. The areas to be examined will be determined based on project plans and in consultation with construction staff and the qualified paleontologist during pre-construction meetings and as needed throughout the construction process.

b. Ensure that if subsurface paleontological resources are identified by the principal paleontologist during construction, all construction activities in the area of identified paleontological resources will be temporarily halted so that the resources may be documented and as determined by the Museum recovered. All resources shall be documented on appropriate forms approved by the Museum and these will be placed on file in the Museum.

c. Ensure that any paleontological resources, including asphaltic deposits containing fossils and/or archaeological objects, will be recovered in accordance with best practices outlined by the Museum (Attachment 1).

d. Require that the principal paleontologist has designated and secured space sufficient to store and, if necessary, analyze and process boxed or individual fossil deposits for preparation [but see section 2.b].

e. Require that the principal paleontologist record all data and, if necessary, perform excavation of boxed deposits or individual fossils, prepare fossils and store fossils prior to curation in accordance with best practices outlined by the Museum (Attachment 2, which may be modified from time to time and agreed to by the Parties).

f. Require that the principal paleontologist provide periodic progress reports including copies of all field notes to Metro and Museum in addition to the preparation of a comprehensive final report prepared in accordance with appropriate state and federal standards. The original copies of the field notes will be archived in the Page Museum at the time that the fossils are transferred to its jurisdiction.

g. Provide funding for required fossil recovery, processing, curation and temporary storage and any other fossil-related Museum activities specified in Paragraph 2 based on an annual work plan to be submitted by Museum and agreed upon by Metro. This annual work plan will:

    1. Be based in part on the Museum's experience in processing and storage of its Project 23 materials, taking into account the possible variation in the density of fossils and in the matrix in which the fossils are found. Reflect storage

requirements based on the anticipated quantities of fossils anticipated to be recovered in the year.

2. Be subject to revision based on unanticipated greater or lesser number and size of fossils encountered.
3. This Agreement provides for Metro's total contribution to the cost of permanent storage premises in the event that significant quantities of fossils are recovered.
4. The Museum staff cost element of annual work plan will reflect payment rates agreed on in the first MOU at Metro Form 60s adjusted over time for inflation, promotions, etc.
5. This Agreement shall prevent unreasonable payment if few fossils are found, but assure payment for vital effort.
6. The Museum staff shall submit a proposal for the Annual Work Plan no later than February 28 of each calendar year

h. Provide funding to the Museum or the Foundation for final permanent storage of paleontological resource recovery, except that Metro's funding shall be limited to the approved life of project budget, the project's duration and federal funding guidelines:

    1. The funding and payment schedule will be agreed to by both Parties after the end of excavation for the Wilshire/Fairfax Station.
    2. The Parties also agree that if significant paleontological resources are discovered and recovered, but it becomes difficult to determine the full scope and timing of the permanent storage needs for the resources, and recognizing that the storage needs will run beyond the term and scope of the Project, the Parties may agree on a one-time present value payment by Metro to Museum that will equal a negotiated agreed upon cost that, when payment has been made\.
    3. The one-time payment shall satisfy Metro's obligation to provide permanent long term storage of the paleontological resources.
    4. This approach will permit the Museum to spend the appropriate time necessary to recover, restore, analyze, display or store the resources in accordance with the Museum's policies and practices.

i. Allow the Museum to be involved, in an oversight capacity, for all field and laboratory work to ensure that Museum standards are being maintained.

j. Require that paleontological resources be removed expeditiously to allow Project completion according to schedule, but in compliance with Museum standards as recently demonstrated in the construction of the new LACMA Underground Garage and corresponding Project 23 Paleontological Project.

k. Retain responsibility for compliance with all legal and regulatory provisions related to monitoring, reporting, consultation, and repatriation of Native American remains and related material, including under Native American Graves Protection and Repatriation Act and California law.

l. Assign a Metro Representative to make any further revisions or adjustments to this document necessary in the course of the project, in cooperation with the Museum.

m. Designate the Museum as the sole source for the scientific description of fossils and artifacts recovered from the Purple Line Extension Project in asphaltic deposits associated with the Wilshire/Fairfax Station and other portions of the Purple Line Extension Project alignment within two miles of the Wilshire/Fairfax Station. Publicity concerning the discovery of such fossils and artifacts shall be jointly undertaken by Metro and the Los Angeles County Museum of Natural History.

n. In the event of extraordinary need, Metro Planning shall work cooperatively with Museum to prepare grant applications to secure additional funding and resources.

2. **Museum's Duties and Obligations:**

a. Continue to make available Museum personnel to provide oversight of all field and laboratory work on paleontological resources for the duration of the project to ensure that Museum standards are being maintained, as was successfully done on the recently completed Metro Exploratory Shaft near the Museum.

b. Provide an option, dependent upon the volume and number of fossils recovered, , that the Museum will directly house boxed fossil deposits and internally perform excavation and preparation of those deposits for compensation comparable to that offered to the principal paleontologist for similar services.

c. Provide for the professional care and management of the curated paleontological resources associated with the Wilshire/Fairfax Station and other portions of the Purple Line Extension Project alignment within two miles of the Wilshire/Fairfax Station.

d. Ensure that personnel assigned responsibilities related to the Purple Line Extension Project are qualified museum professionals whose expertise is appropriate to the nature and content of the paleontological resources recovered.

e. Provide and maintain a repository facility having requisite equipment, space and adequate safeguards for the physical security and controlled environment for the paleontological resources (but see 1.h).

f. Perform those conservation treatments necessary to ensure the physical stability and integrity of the paleontological resources prepared by the principal paleontologist.

g. Curate the paleontological resources to ensure adequate scientific documentation of the circumstances of their recovery.

i. Make reference to Metro's participation when the Collection or portions thereof are exhibited, photographed or otherwise reproduced and studied in accordance with the terms and conditions of Museum policy with the statement: "In Cooperation with the

Federal Transit Administration and Los Angeles County Metropolitan Transportation Authority". The Museum agrees to provide the Agency with copies of any resulting publications.

3. **Paleontological Advisory Board**

The Parties agree to mutually appoint a three person Paleontological Advisory Board comprised of appropriately qualified paleontologists to help guide this effort as previously agreed by the Parties in their Paleontological MOUs for this site in 1983 and November 2, 2011.

**IN WITNESS WHEREOF**, the Parties hereto have executed this Amendment No. 1.

| | |
|---|---|
| ______________________________ | ______________________ |
| Dr. Jane Pisano<br>President and Director<br>Los Angeles County Museum of Natural History | Date |

Approved as to form:

| | |
|---|---|
| ______________________________ | ______________________ |
| MARY C. WICKHAM<br>County Counsel | Date |

By: ____________
Deputy

| | |
|---|---|
| ______________________________ | ______________________ |
| Phillip A. Washington<br>Chief Executive Officer<br>Los Angeles County Metropolitan Transportation Authority | Date |

**ATTACHMENTS**

Attachment 1. Paleontological Methods for Mitigation of Fossils in the Vicinity of Hancock Park

Attachment 2. Techniques for Excavation, Preparation and Curation of Fossils from the Project 23 Salvage at Rancho La Brea

Attachment 3. Wilshire/Fairfax Station Construction Methodology

Attachment 4. Paleontological Resources Monitoring and Mitigation Plan

# ATTACHMENT 1

# Attachment 1—Paleontological Methods for Mitigation of Fossils in the Vicinity of Hancock Park

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# ATTACHMENT 1

## Paleontological Methods for Mitigation of Fossils in the Vicinity of Hancock Park

# Paleontological methods for mitigation of fossils in the vicinity of Hancock Park.



Images courtesy of ArchaeoPaleo Resource Management, Inc.

2011

# TABLE OF CONTENTS

# Introduction

Rancho La Brea is the world's richest Ice Age fossil locality, yielding well over 3 million fossils and representing more than 600 species of animals and plants that lived in the Los Angeles Basin between 11,000 and 50,000 years ago. The asphaltic fossil deposits generally occur in randomly distributed inverted cone-shaped masses between 10 to 35 feet in depth. The sizes of the accumulations vary considerably from less than 5 cubic feet to more than 20 cubic feet. Flat tabular deposits such as that recovered during the construction of the Page Museum are rare. Ideally, the fossil accumulations should be carefully excavated as they are discovered. The fall back position is to remove the deposit intact, preserving it for excavation at a later date. This methodology, developed during the mitigation of the LACMA underground parking structure, preserves stratigraphic integrity, permits less hurried excavation under more optimum conditions, maximizes fossil and information retrieval, and enhances opportunities for major discoveries and new scientific contributions. All data pertaining to the location and condition of newly discovered fossil deposits must be recorded and photographed as outlined later in this document.

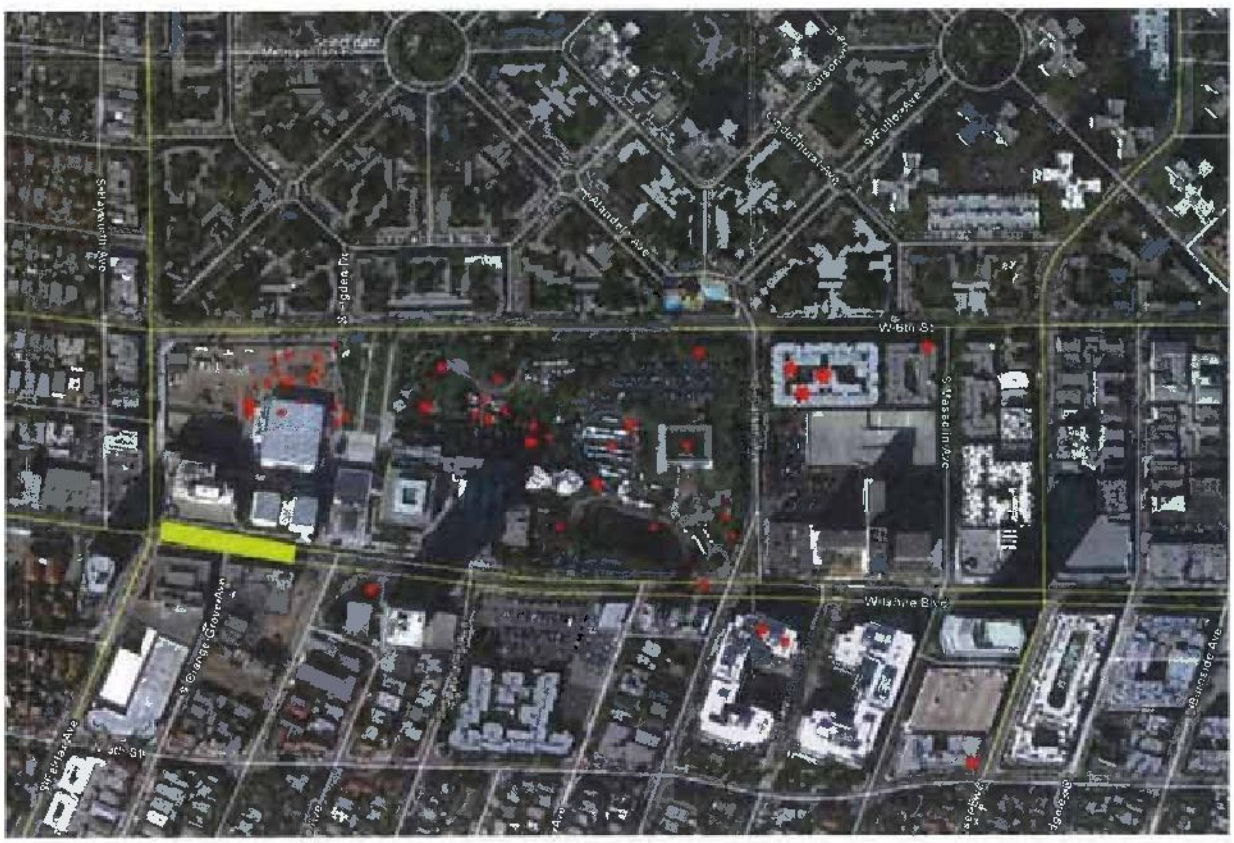


**Fig 1: Map of Hancock Park** and vicinity with known asphalt preserved fossil localities (red stars) and the approximate location of the proposed MTA subway station (yellow rectangle)

## Fig 2: Monitoring

All excavation activity must be carefully monitored. In areas of asphaltic sediment or other areas where fossils have been discovered, sediment should be removed in 4-6" levels while paleontologists monitor closely. The monitors are empowered to halt the process as soon as fossils are located.

**Fig 3: Fossils are discovered**

After a fossil deposit has been located the surrounding area must be roped off so that paleontologists can determine the extent of the deposit or if it is an isolated fossil. In the case of an accumulation deposit this may range from 5 feet to 20 or more feet across. Construction work in the immediate vicinity of the fossil deposit must be halted temporarily but may proceed normally elsewhere in the construction site. Asphalt saturated conical shaped deposits and isolated fossil mitigation are described separately below.

## Taking Field notes

Whether an accumulation of fossils are discovered or an isolated fossil is found, detailed field notes must be taken. The precise locality of each fossil deposit must be recorded with a resource-grade GPS device, its extent clearly described, mapped, and photographed on site using conventional field data collection methods, and its context including represented lithologies and depositional environments must be described. Types of geologic information to be collected should include: the nature of bounding contacts (erosional, sharp, gradational), thickness, geometry, grain size, shape, and sorting, color (fresh and weathered, use a color chart), sedimentary structures (physical and biogenic), cement type, pedogenic features (rooting, nodules, slickensides, etc.), halos, mineral crusts, microstructures around bio-clasts, and other fossils. Types of taphonomic information to be collected should include: taxonomic

representation, skeletal articulation and association, scale and geometry of assemblage, density, and orientation of bones. Bone modification information to be collected should include: weathering, polishing, abrasion, scratch/tooth marks, root traces, borings, fragmentation/breakage, and distortion. Each isolated fossil and each individual fossil deposit must be given an individual field number. This number should be written in permanent ink on individual fossils and clearly marked in permanent marker or paint on the box containing a deposit.

## Asphalt saturated conical shaped deposits

**Fig 4: Pedestal a deposit**

Once the extent of the fossil accumulation has been determined, the sediment surrounding the fossiliferous deposit is carefully removed, isolating the accumulation on a pedestal. It may be necessary for monitors to wear a SCBA, as in this image, because of the high concentrations of hydrogen sulfide.

**Fig 5: View of east end of LACMA construction site**

It is possible that there will be a number of fossil deposits within the construction site. Work may continue at non-fossiliferous locations while the deposits are being salvaged.

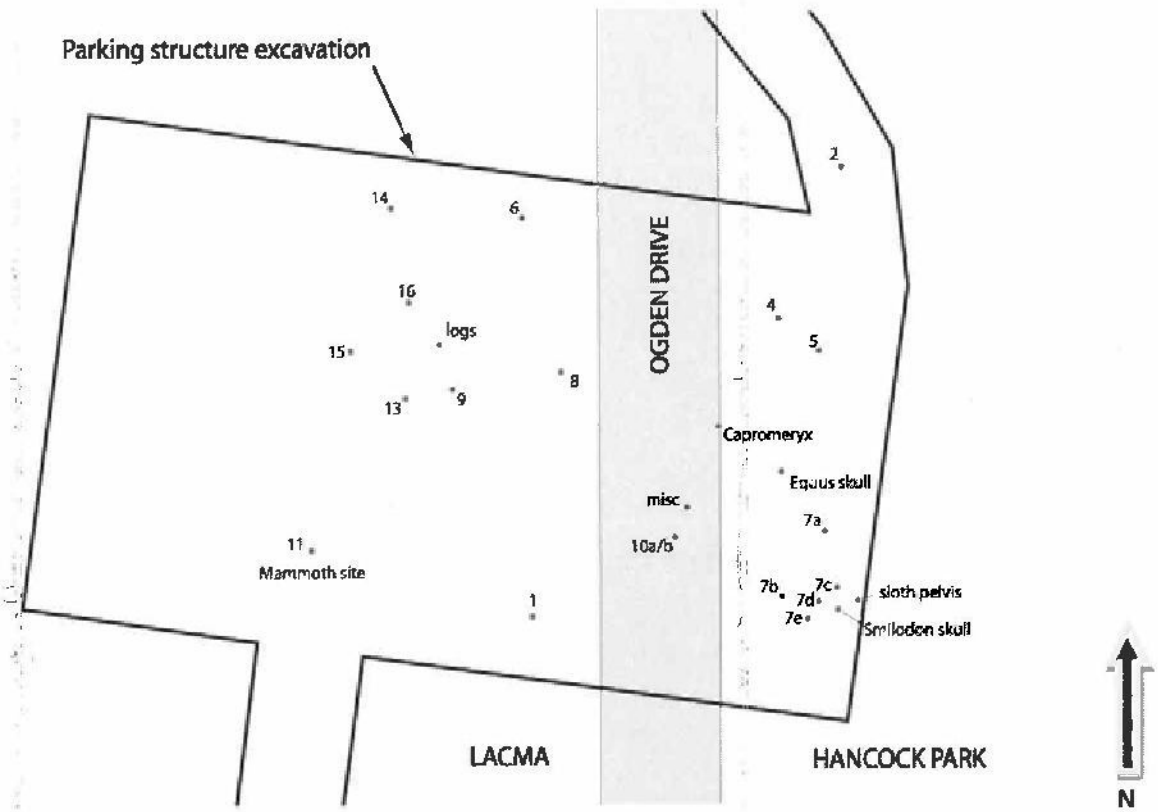


**Fig 6: Map of fossil localities from LACMA parking garage**

These were mostly asphaltic fossiliferous masses but included some occurrences of isolated bones, trees, and other fossils.

**Fig 7: Fossil accumulation pedestals before tree box**

After the deposit has been isolated it will be surrounded by metal bands to conserve its integrity before the box is built and a brightly colored strong plastic or a tarp to keep the deposit dirt separated from the 'fill' dirt.

**Fig 8: Building a tree box around a fossil deposit**

A custom sized box is then built around each deposit by a 'tree boxing' company. Valley Crest was used on the LACMA project. Any space between the plastic-wrapped deposit and the edge of the box must be filled with polyurethane foam, distinctly different sediment or gravel to preserve the integrity of the deposit and to prevent its deformation during subsequent transportation and storage. It is important that the 'fill' sediment be easily recognizable from the matrix during later excavation of the deposit.

**Fig 9: Secure the tree box with metal bands**

After the sides of the box are nailed into place, metal bands are added to secure and strengthen the sides of the box.

**Fig 10: Tunnel under the tree box**

After the sides of the box are secured and banded, the sediment beneath the box is removed by tunneling so that the box floor can be constructed. The field number and locality data must be clearly written on the outside of the box in permanent marker or paint. The orientation of the box and the depth below datum of the top and bottom of the deposit must also be clearly and permanently marked on the box, as well as added to the field notes for that deposit.

**Figs 11, 12 & 13: Relocating the tree boxes by crane and truck**

A crane is used to lift the completed boxes, load them onto a flat bed truck, and to relocate them to the place where their excavation will take place.

## Isolated fossils

In addition to conical and flat tabular asphaltic accumulations, construction activities may encounter isolated fossils in non-asphaltic or asphaltic sediments such as the trees, mammoth skeleton, and bison and horse skulls that were discovered during the recent construction of the LACMA's underground parking structure. Similar procedures pertain. The area must be roped off in order for the monitors to determine the extent of the fossil occurrence, which may then be removed using conventional paleontological field techniques. Large or fragile bones must be pedestaled (with sediments immediately surrounding the fossil) and covered in a plaster and burlap jacket. The type of plaster used determines the time it takes to dry. Once the plaster is dry, it is flipped over and the other side is covered with plaster and burlap and left to dry completely. In the meantime paleontologists need to determine the extent of other isolated fossils in the area looking in particular for other elements of the skeleton of the jacketed specimen or sediments in which microfossils such as rodent, bird and reptile remains may occur.

It is crucial; that all isolated fossil occurrences be given a field number, their location recorded with a resource-grade GPS device, and these data entered into the field notes together with a map and description of the fossil, its orientation and its locality including description of the lithology in which the fossil was preserved. Standard guides such as Munsell Soil Color Charts should be used. The field number should be clearly and permanently affixed to the fossil and written on its container or jacket as appropriate. Maps must have a legend and scale to the show the orientation and depths of each fossil as well as a datum point. In addition to the field number, plaster jackets should also be marked "field side up" on the appropriate surface.

**Fig 14: Excavating isolated fossils**

Paleontologists need to excavate around large bones with hand tools before covering them with a protective plaster jacket for later removal and transport.

**Fig 15: Mammoth discovered**

This image show the mammoth locality in the context of the construction site during the LACMA underground parking garage.

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# ATTACHMENT 2

# Attachment 2—Techniques for Excavation, Preparation and Curation of Fossils from the Project 23 Salvage at Rancho La Brea

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# ATTACHMENT 2

## Techniques for Excavation, Preparation and Curation of Fossils from the Project 23 Salvage at Rancho La Brea

# Techniques for excavation, preparation and curation of fossils from the Project 23 salvage at Rancho La Brea.

A MANUAL FOR THE RESEARCH AND COLLECTIONS STAFF OF THE GEORGE C. PAGE MUSEUM



2011

# TABLE OF CONTENTS

# Introduction

This document was compiled mid project to record and codify best practices for excavation, preparation and curation of specimens from Project 23 and other Rancho La Brea localities that are housed in the George C. Page Museum. Some of the techniques are similar to Pit 91 excavations that were reported by Shaw (1982) and others that are unique to Project 23 because of the nature of the salvage. This provides guidelines for possible future salvage efforts. Documents discussing the nature of the mitigation are available elsewhere.

# Excavation Techniques for Project 23

Excavation of Project 23 deposits began in August, 2008. The measuring techniques used to determine and record data for *in situ* specimens follow those of Shaw (1982) for Pit 91 with some modifications described here (for instance, the imperial measurement system was used prior to Project 23). New excavation procedures have also been devised as a result of the removal of the deposits from their original location due to construction.

In Project 23, a custom-sized wooden box was built around each isolated plastic-wrapped deposit by a 'tree boxing' company (Valley Crest was used for this particular project). Any space between the deposit and the edge of the box was filled with either polyurethane foam or sediment to preserve the integrity of the deposit and to prevent its deformation during subsequent transportation and storage.

Because the deposits are no longer *in situ*, all excavation grids are oriented with respect to the deposits' original north orientation. Where feasible, box walls may be removed in part or in their entirety to allow excavation from the side of the deposit rather than from the top. Each "tree box" from Project 23 is treated differently depending on the type of deposit, size of the box and integrity of the sediments in the box. Refer to paleo mitigation protocol and ArchaeoPaleo report documents for descriptions on how the 'tree boxes' were constructed.

## Preparing a tree box for excavation

First read all the field notes pertinent to that particular deposit. In a field notebook or deposit logbook document the nature of the "box" size, construction, fill, plastic, etc. If the box is taller than 5 feet, erect scaffolding for excavators to safely access the box. Depending on the size of

the tree box it may be necessary to construct a safety railing extending upward from the sides of the box. After the top of the box is safe to access, remove the metal bands that are strapped across the top of box. Use specific snips if recommended by the tree boxing company. Remove supportive fill dirt, foam and plastic to reveal deposit surface, taking care to maintain an appropriate area for excavators to work safely.

Depending on box stability and size, board walls or portions of board walls may be removed to enable excavation from the side of the deposit. Smaller boxes containing deposits with cohesive sediments may allow the removal of all sidewalls. For larger boxes, removal of one wall or a small "window" cut into a sidewall may be feasible.

Before any asphaltic sediment is removed, set up a gas monitor close to where work will be conducted. The Solaris Multigas Detector is an economical, 4-gas instrument providing simultaneous detection of CO, O2, H2S and combustible gas and costs ~$600 from Safety Tek Industries.

## Grid layout

Determine the deposit's north side from field data and data written on the box.

Establish a datum point near the top of the box and record it based on field data. The datum point should not be removed during excavation.

Lay out grids into 1m x 1m squares with origin in the SE corner of the box using an alphanumeric system (N/S = A-Z; W/E = 1, 2, 3). Gridlines can be marked with string, spray paint or chalk and need to be refurbished and maintained periodically. A map of the box showing the grid lines and a north arrow should be drawn for reference.

## Excavation and Documentation

After grids are established, clean surface to remove fill dirt, to determine sediment type and to locate fossils if exposed. Note nature and location of fossils (bones, shells, plant remains, etc.)

Excavate grids in 25 cm spits (i.e. Level 1=0cm-25cm, L2=25cm-50cm, etc). If multiple grids are worked on at the same time, ensure that this doesn't compromise the mapping of each spit wall and floor. If a deposit has been exposed from the side, the spits in any one grid may be excavated sequentially from the top to the base of the deposit.

Depending on degree of consolidation, use small hand tools (hammers, chisels, and screwdrivers as required) on non-fossiliferous areas. Pneumatic or electric hammers can be used on areas with hard matrix where there are no fossils. Use dental picks and small screwdrivers to expose and extract fossils. Hard asphaltic matrix can be softened with clamp lamps or loosened with a small amount of solvent. Measure exposed fossils *in situ* (see below) within each grid and record their data in field notes before extracting them.

Note: Clamp lamps should be placed at least 8" away from the specimens and always monitored. Never leave lamps unattended. If the sediments start to smoke immediately turn off the lamp. 150 watt incandescent unfrosted bulbs should be used.

Save all of the surrounding sediments but separate them based on sediment type into 5 gallon metal buckets with lids. The pre-designated sediment types are A= asphaltic sand, B=brown silts and C=clay. Mark each bucket with box #, grid and level data as well as the sediment type (A, B or C). Note the number of buckets of each sediment type from each grid on an inventory list kept by the lead excavator. This is important because it determines how each bucket is processed later (see matrix processing section).

Keep daily documentation in field notes of who is excavating, a list of the grid or grids being excavated and describe the type of matrix being removed, what is being found within each grid, and any challenges encountered with the excavation. Geologic and paleobiological data should be recorded in field notes for later use to constrain and further refine taphonomic, paleoenvironmental, and paleobiological interpretations. A description of each lithology (soil type) should include color (fresh and weathered), lithologic composition, grain size, sorting and shape, sedimentary structures, induration, type of cement, fossil content, and pedogenic features (rooting, nodules, slickensides, etc.). As excavation proceeds note unit thickness, nature of the bounding contacts (erosional, sharp, gradational), and inferred depositional setting. Note nature and location of fossils (bones, shells, plant remains, etc.). Any visible modifications to the bones (weathering, polish, abrasion, scratch/tooth marks, root traces, borings, pitwear, breakage, distortion) and gross orientation should be recorded. Features of the matrix surrounding the bones, such as alteration halos, mineral crusts, micro-structures, fine root traces (small burrows or borings), and localized invertebrate bioturbation should be noted. The degree and nature of articulated, semi-articulated, associated, and dissociated skeletal elements should be described. Notes should also be taken on the general geometry of the fossil deposit (vertical pipe, tabular, etc.) drawings and/or photographs should be taken when appropriate.

## Measurement system

The most common types of macrofossils recovered from asphaltic deposits are isolated bones. The following measurement system has been devised for capturing data for individual bones.

See the Special Cases section for the treatment of associated skeletons, dermal ossicles, plant masses, etc.

*In situ* measurements are taken from specific anatomical points on each bone (see Table 1 and 2 Appendix A) to define its spatial orientation with reference to its depth below an established datum point (BD), its distance north (N) of the southern grid line and its distance west (W) of the east grid line using the metric system (see Fig 1. of Shaw (1982) but note this uses the imperial measurement system). Recording this data at the time of excavation will facilitate studies of stream current energy and direction, deposition, and taphonomy.

All identifiable bones from 1 cm to 2 cm in size should be measured *in situ* as a 1-point measurement before being excavated. Each Standard Measurement (BD, N, W) is taken to the center point of the longest dimension (Fig. 3)

Bones larger than 2cm in minimum length or diameter should be measured as either a 2-point or a 3-point measurement. The 3-point measurement is used on all bones in which three predetermined identifiable anatomical points are visible. The 2-point measurement is used if the bone lacks three distinct reference points and records the orientation of the long axis of the specimen (proximal-distal, anterior-posterior, medial-lateral, etc.). Detailed instructions for measuring out specimens are provided by Shaw (1982), which also lists the elements that generally fall into each of these categories.

All the data pertinent to the specimen should be recorded in the field notebook and should also accompany the specimen until its preparation and curation have been completed. One method of doing this is to duplicate the field notebook entries onto a 3" x 5" card using carbon paper (Fig 1, 2 and 3 below). This card then accompanies the specimen throughout its preparation, curation, and final cataloging. Only when the data have been recorded in the catalog are they separated.

In addition to measurements on individual bones, the dip of all limb bones and skulls should be recorded with a Brunton compass. Recording these data at the time of excavation will assist with interpretation of stream current energy and direction, and taphonomy which may include possible vertical movement in a vent, trampling, etc.

The soil type surrounding each measured bone should also be noted on the 3" x 5" card by a letter using a pre-designated lettering system. The pre-designated sediment types are A= asphaltic sand, B=brown silts and C=clay.

After a bone has been measured *in situ*, it is placed in an appropriate sized clear plastic bag. The 3" x 5" data card is placed in its own small clear plastic bag for safety and then placed in the bag with the bone.

**Fig 1: Example of excavation data for a 3-point measurement in a field notebook and transcribed onto a 3" x 5" card template.**

| | | | |
|---|---|---|---|
| P23-14 | B3/L4 | | |
| | GT | Px | Dt |
| BD = | 58cm | 53cm | 64cm |
| N = | 31cm | 35cm | 31cm |
| W = | 13cm | 10cm | 90cm |
| *Canis dirus* femur | | | |
| | | | Soil type= A |
| | | | Dip=30°SW |
| | | | Excavator initials and date |

**P23-14 = Project 23-Box 14**
**B3/L4 = grid B3/level 75cm-100cm**

**GT = Greater Trochanter is 58cm below datum, 31cm from the south grid axis and 13cm for the east axis**
**Px = Proximal end is 53cm below datum, 35cm from the south grid axis and 10cm from the east axis**
**Dt = Distal end is 64cm below datum, 31cm from the south axis and 90cm from the east axis**

**Soil type A= asphaltic sand**

**Fig 2: Excavation data for a 2-point measurement in a field notebook and transcribed onto a 3" x 5" card template.**

| | | | |
|---|---|---|---|
| P23-1 | B1/L2 | | |
| | Px | Dt | |
| BD = | 53cm | 64cm | |
| N = | 35cm | 31cm | |
| W = | 10cm | 90cm | |
| Canid juv. radius | | | |
| | | | Soil type= B |
| | | | Dip=1°SW |
| | | | Excavator initials and date |

**P23-1 = Project 23-Box 1**
**B1/L2 = grid B1/level 25cm-50cm**

**Px = Proximal end is 53cm below datum, 35cm from the south grid axis and 10cm from the east axis**
**Dt = Distal end is 64cm below datum, 31cm from the south axis and 90cm from the east axis**

**Soil type B= brown silt**

**Fig 3: Excavation data for a 1-point measurement in a field notebook and transcribed onto a 3" x 5" card template.**

| | | |
|---|---|---|
| P23-5B | D3/L7 | |
| BD = 20 cm | | |
| N = 10cm | | |
| W = 15cm | | |
| Rodent tooth | | |
| | | Soil type=C |
| | | Excavator initials and date |

**P23-5B = Project 23-Box 5B**
**D3/L7 = grid D3/level 150cm-175cm**

**20cm below datum**
**10cm from south gridline**
**15cm from east gridline**

**Soil type=clay**

Specimens smaller than 1 cm, fragments, or unidentifiable smaller bones are placed into "bulk matrix bags" together with field data cards (P23-deposit # and grid/level information, excavator initials and date). Because they are known to contain fossils, the bulk matrix bags will be processed before the rest of the matrix samples. Keep associated fragments together in capsules or envelopes within the bag. Be sure to always place delicate bones into snap cap vials first and then into a clear plastic bag with their data. If a fossil is not in place, identify it and label it "not *in situ*"

## Special cases

Each special case requires consultation by lab and collections staff to assess the best way of documenting each potentially unique occurrence.

- An articulated or associated skeleton should be extensively photographed. If, after consultation with Lab and collection staff this is removed as a small block, be sure to place a white pin in the top surface along the northern middle portion of the block so that it can be oriented later. Draw and annotate a diagram of the block and the elements that are visible on each surface before it is removed. Measure out the block as a 2-point measurement. Elements within the block that can be identified and measured without compromising the specimens should be also noted and can be measured using the 1 or 2-point measurement system but should not be removed from the block. Labeled copies of all photographs should be placed in the bag with the specimen. This is additional to downloading the photographs to the archive computer (see photography section). Articulated or semi-articulated specimens should be extracted in articulation and the sediments around the specimens stabilized to conserve the maximum amount of information derivable from the specimen.

- Bone masses with poorly preserved specimens (fragmented and/or less asphalt-impregnated) are more difficult to measure out individually. Measure out the extent of the mass with the 2-point system rather than the constituent bones. Place a white pin in the top surface along the northern middle portion of the block so that it can be oriented later. Photograph in situ specimens, print and label images and place them in the bag with the specimens.

- As instructed by Lab and collections staff, and depending on their nature and frequency, dermal ossicles and pockets of plant, shell or insect material should either be measured out as a small block with a 2-point measurement (same as above) or placed in pre-labeled bags with locality information for a specific 10cm square within the 1m x 1m grid.

## Geologic Samples

Collect 15 cm by 15 cm soil samples of each sediment type from each grid and level for geologic analysis of composition, weathering, and grain size at a later date. Document each sample in your notebook and measure each one *in situ* as a block using the 2-point measurement system used for fossils and described above. Each sample should have a white pin placed on the upper surface in the northern middle portion of the sample so that later the sample can be oriented. Transcribe all data onto a 3" x 5" card and place in a clear plastic bag with the soil sample. A list of soil samples taken should be kept by the lead excavator for each grid and deposit.

When spits are completed, photograph and map each exposed wall and the floor.

## Floor and Wall mapping

When mapping a wall or floor (Fig. 4, 5 and 6)

- Draw maps on graph paper with a scale of 3 squares = 10 cm.
- Keep the origin point (0, 0) in the southeast corner.
- Mark north arrow.
- Draw in empty spaces and the edge of the box when present.
- Mark asphalt and sediment contacts.
- Use standardized symbols for lithologies and other known sedimentary features. Also
- Indicate where fossils, cobbles, bone, shells and plants masses are located (Fig 4).

**Figure 4: Standard symbols used in mapping each grid's floor and wall**

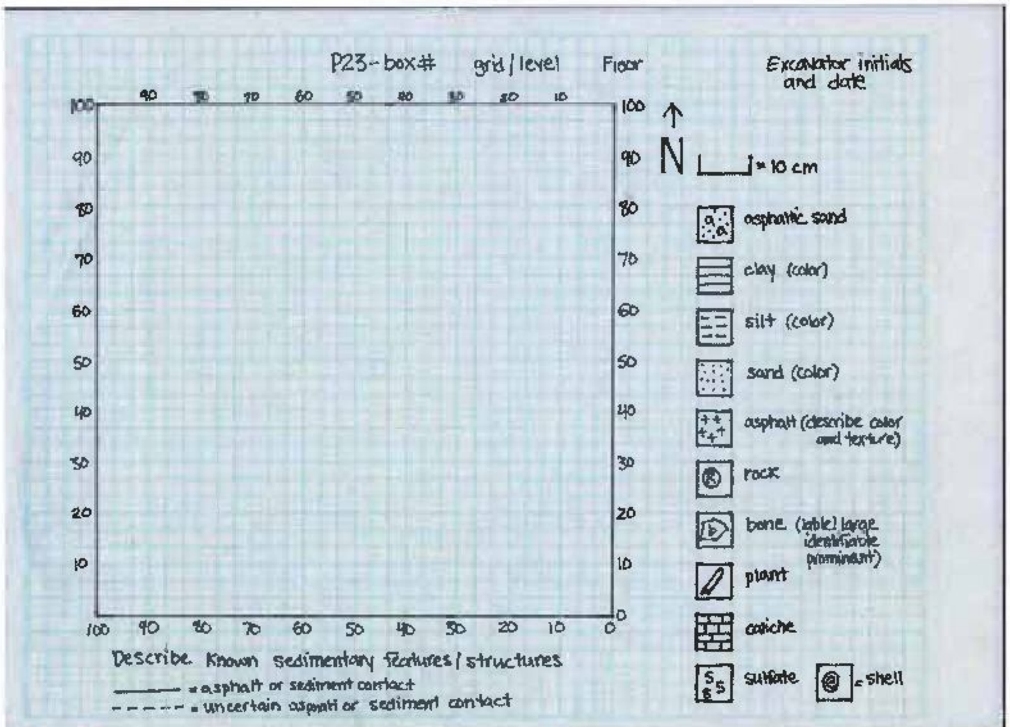



**Figure 5: Sample drawing of the floor of grid C3/L3 of box 14**

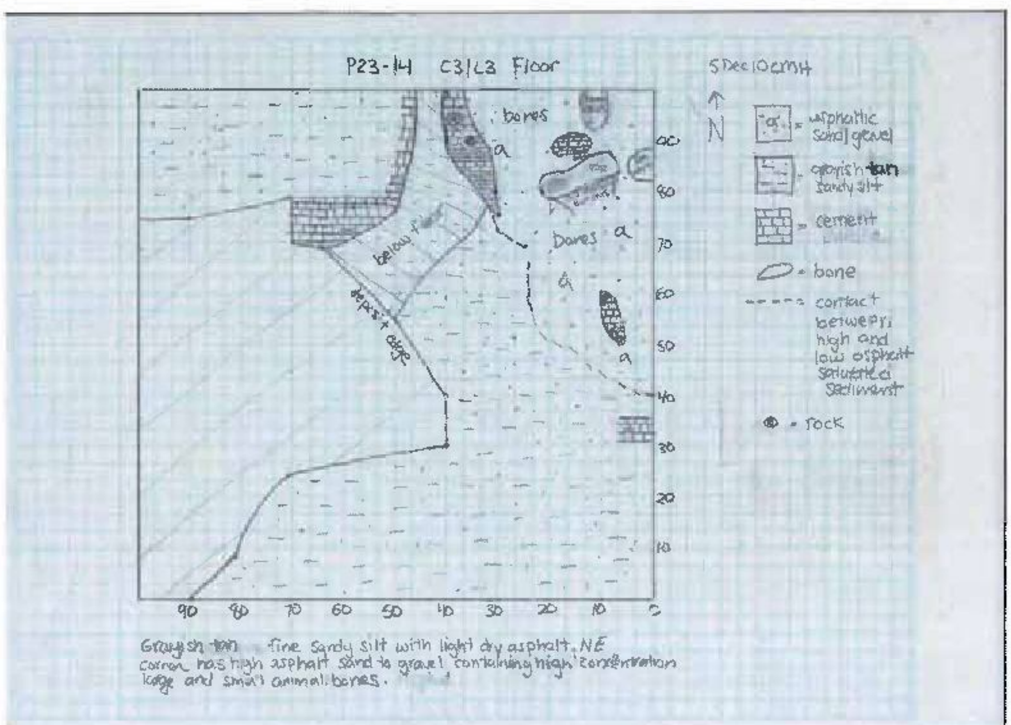
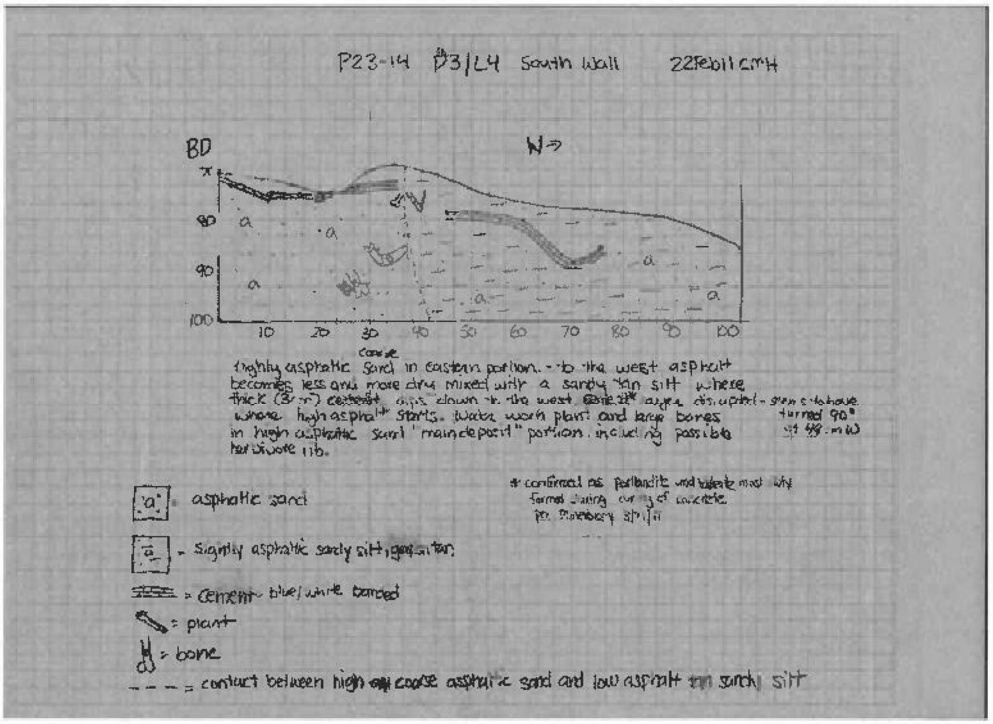


**Figure 6: sample drawing of the south wall of grid D3/L4 of box 14**




# Photography

Photo documentation and the labeling of downloaded images are very important. In the field photo logbook provided, record all the images that you take. This is shared by everyone and has columns for name of photographer, date, box #, grid and level, orientation of image, file number and special notes. Take a photograph whenever it might be useful for lab staff and researchers to see how a specimen was oriented in the ground, broken in a certain way or for any other unusual circumstance. Always photograph the floor and each wall of a grid before starting a new one.

<u>When photographing a specimen:</u>

Write the project name, box #, grid and level #'s, orientation, description of what you are photographing, the date and excavator initials on a 3"x 5" card with a black sharpie and place next to the object you are photographing.

For example:

| |
|---|
| P23-14 C3/L3 |
| Skull , ventral view ↑ |
| N |
| Excavator initials and date |

Print the photo as soon as possible and place it in the bag with the specimen. This may not be necessary for all the images of *in situ* specimens, so make a judgment call here.

When photographing a floor or wall:

- Write the project name, box #, grid and level #'s, orientation, the date and excavator initials on a 3"x 5" card with a black sharpie.

For example:

| |
|---|
| P23-14 C3/L3 |
| South Wall ↑ |
| Excavator initials and date N |

- Place meter sticks in north and west orientation.
- Take a picture of each exposed wall and floor with the card and meter sticks in frame so as not to cover up any significant features and so the information on the card can be used to tag the photograph in the database.

Download all photographic images to the archive computer and place in the folder "to be sorted" under My Pictures\Project23 under the project 23 login. Rename your files appropriately so that they can be retrieved, tagged in Adobe Bridge and added to the EMu database. This is where the photo logbook will be useful. Each image should be named with the following conventions in order to be searchable in the database:

1. If it is a photo of a grid and a level then name it P23-1 B1 L2 where P23-1 refers to the Box number, B1 refers to the grid and L2 refers to the level. Notice a space between P23-1 and B1 and also between B1 and L2. This is on purpose and helps the database find the files. If there is no level just enter the information that you have.
2. If it is just an image of several grids just name it with the box number e.g. P23-14.

3. If it is a photo of a possible associated skeleton or a specimen in the ground include some more information such as what it might be e.g. P23-1 B1 L2 bird skeleton

## Data entry of field notes

Write field notes in pre-bound notebooks. For each day compile a daily journal that includes notes on the weather, who was working, general work done that day, grids being worked on, etc. as well as geological information on open grids and specimen measurements. On a weekly basis all excavation notes, photographs and grid drawings will be captured electronically.

- Type journal entries into word documents with each day saved as a new file. The naming convention of the file should be "project yearmonthday initials" (e.g. P23 20090201 ABF). Within the word doc file at the top of the page type the initials of the excavator and the date. This serves as a search tool for the database. Save these to the flash drive that is provided. The Collections Manager will import these data into the database.
- Type specimen measurement data into a pre-prepared Excel spreadsheet and save to the flash drive provided. The Collections Manager will import these data into the database.
- The floor and wall drawings and photographs for each grid must be scanned and downloaded onto the archive computer at the Page Museum.

## Matrix processing

There are two different ways that matrix from the excavation is processed. All asphaltic matrix from or adjacent to asphaltic bone concentrations needs to be processed with solvent in a vapor degreaser in order to release small bones and other plant, insect, invertebrate and vertebrate remains from the asphalt. After degreasing, the matrix is dried and dry screened to remove the clay-to-silt fraction. The remaining concentrate is sorted for microfossils under a microscope.

Samples of other (apparently non-fossiliferous) non-asphaltic sediments are screen-washed in water on 20 mesh screens and the concentrates are sorted for microfossils under a microscope. If there is no evidence of microfossils in the sample, the remaining material from that facies of that grid may be discarded (except for the 15 cm archival cube that was collected during excavation of the grid).

## Laboratory Protocols

All material sent to the Lab for cleaning is triaged to resolve appropriate methodology, account for the skill level of available lab workers, and for research and collection priorities. An n-propyl bromide solvent is used to remove asphalt from the bones. Trade names for this solvent include Lenium, GenTech and EcoMax. Elmers white glue is used to repair broken bones and Acryloid (Paraloid) B-72 (Ethyl methacrylate copolymer) is occasionally used to consolidate dry bones.

## Prioritize new specimens

1. For cleaning method
   - Sort and store by locality, grid, depth.
   - Sub-sort by best cleaning method: ultrasonic, soaking, or hand prep.
2. For significance
   - Rareness of taxon
   - Incomplete section of previously excavated specimen
   - New element of known individual skeleton from that locality
   - Unrecognizable to element or taxon.

## Ultrasonic cleaning

Ultrasonic cleaning can be used for the following types of specimens:

- Complete or sturdy bones measured in individually (examples include *Smilodon* or *Canis dirus* carpals, tarsals, phalanges)
- Complete or mostly intact avian bones. The feasibility of processing other fragile bones, including broken small bones, should be assessed by the person who will be re-assembling them.
- Shells, insects, and concentrations of mollusks or insects from within known locality with measurements.

**Steps to be followed**

1. Place each specimen or sample in a baby food-sized jar with all contents of envelope.
2. With pencil, number the envelope and the top of the jar (on masking tape).
3. Prepare six jars as above.
4. Fill with solvent to an equal level in all jars.
5. Place in ultrasonic tank and fill with water up to the level of solvent in jars.
6. Buzz for fifteen minutes.
7. Strain contents of jar through 20 mesh screen on top of pitcher.
8. Rinse with clean solvent.
9. Check specimen or sample for matrix, detail with brush or skewer as needed.
10. Place each specimen or sample on separate paper tray, with flipped out matrix, data, and masking tape number from jar top.
11. Let dry over night, polish, and sort matrix.
12. Solvent that was strained into pitcher can be reused for setting up next batch of six jars if not too dirty.

## Pre-soaking

- Large bone masses: If there is no single identifiable bone, put it in a large jar or a bucket with more solvent than volume of mass. Mass may require a second rinse if solvent becomes too thick with asphalt.
- Unusually hard matrix: Put all of the specimen and loose matrix in jar with data taped to lid.
- Broken *in situ* specimens: If matrix is in internal structure of bone, soak and rinse.

## Hand preparation

- Individual specimens with positional data include vertebrae, ribs, long bones, etc. that are relatively complete.

**Steps to be followed**

1. Rubber stamp, date, and write the signature of preparator on back of data card.
2. Empty all contents of plastic bag or envelope into stainless steel pan.
3. Wet specimen with solvent from squirt bottle.
4. Scrub with tooth brush, dipped in small jar of solvent (n-propyl bromide)
5. DISOLVE MATRIX, DO NOT PUSH OFF WITH BRUSH OR OTHER TOOL.
6. Wood skewers or sticks can be used to loosen or nudge matrix off (If the stick breaks, the matrix is not soft enough yet)
7. When specimens appear clean, rinse thoroughly with solvent and immediately hold in front of vent for quick dry. Matrix still adhering to specimen will be black or darker than bone.
8. DENTAL TOOLS ARE TO BE USED FOR THE REMOVAL OF VISIBLE ROCKS ONLY!
9. When the entire matrix has been removed, place specimen, data card and jarred contents of metal pan matrix on paper tray lined with paper towels to dry.
10. DO NOT GLUE UNTIL ALL MATRIX IS SORTED.

- Multiple pieces of one specimen.

1. Should be prepared by one person but treated as separate projects.
2. Finished elements held until all parts are done.
3. If glued, the part that goes with which data should be recorded in pencil on back of data card.

- Possibly associated elements of one individual

1. Treat as above but can be cleaned by multiple preparators.
2. Label for possible association with a known skeleton or a single other element. [more specific].

- Skulls

  1. External surfaces should be freed of larger associated specimens and gross matrix clumps using toothbrushes and solvent.
  2. DO NOT POKE IN EARS, NOSE OR BRAIN CASE.
  3. At the end of session, immerse in solvent in sealable bucket with copy of data on lid.
  4. Soak for two or three days.
  5. Hold skull over bucket and flush with clean solvent to remove loose matrix.
  6. Working in metal tray, nudge with skewers to loosen softened matrix and rinse off.
  7. Add removed matrix back into bucket.
  8. Replace skull in bucket at end of session.
  9. If the tympanic bulla is intact, nudge and rinse ear region over metal pan and process matrix separately for ear ossicles.
  10. When brain case and nasal region are mostly free of matrix, skull will not need to continue to soak and can dry between sessions.
  11. Strain contents of bucket.

## Polishing

- When specimen has dried overnight, go over small sections of solid bone with a dampened **soft cloth**, then go over the same space with a dry cloth. Exposed cancellous tissue should be <u>blotted</u> with a damp rag. Not rubbed!
- If there are small spaces that cannot be reached with a rag use a pipe cleaner or Q-tip. Dip it in solvent and blot off some liquid before applying. IF THE SPECIMEN GETS DARKER OR BEGINS TO LEAK ASPHALT, IT IS TOO WET. Put aside for a day and begin again.

## Processing Matrix from Individual specimens

- Processing sediment that has been soaked in solvent. (most common situation)

1. Pour contents through 20 mesh screen sitting on funnel into carboy.
2. Rinse with clean solvent.
3. With one motion, flip contents onto paper toweling on a paper tray.
4. Make sure everything is out of jar and out of screen.
5. Place tray near vent to dry.
6. When completely dry, sift and put in appropriate sized jar for later sorting.
7. If matrix appears clumpy after sifting, re-soak in solvent.
8. If matrix appears dirty with clay or silt after sifting, soak in hot water with a small amount (1 tsp) of detergent)

- Processing soaked in water sediment.
  1. Pour contents of jar through 20 mesh screen in a basin in the sink.
  2. Agitate the screen in clean warm water.
  3. Flip contents onto newspaper and leave screen on top to thoroughly dry.

## Microfossil sorting

When the matrix from an individual specimen is clean and dry it is ready for microfossil sorting.

Take the entire project (specimen, data and matrix) to a sorting station.

Do not pour out more matrix than you have time to sort. Only 1½ to 2 Tbs. may take several hours.

1. Sifting
   - Always sift matrix before sorting even if it was sifted before putting in a jar.
   - Sift through a designated 20 mesh screen with 2 inch sides.
   - Shake back and forth, (not up and down) over a paper towel.

- Empty contents of screen onto a clean piece of white sorting paper and shape matrix into a pile.
- Discard the fine soil that went through the sifter.

2. Sorting
   - Examine matrix, several grains at a time, by moving it across the paper with a fine paintbrush.
   - Create a "discard pile" for sediment and oxidized asphalt.
   - Move bone, plant, shell and insect fossils into distinct piles on one side of the paper.
   - Create a "questions" pile for indeterminate fossils.
   - When the entire matrix has been categorized, review fossils and "discard pile".
   - Have a staff person double check sorting.
   - It may be necessary to examine some specimens under the microscope.

3. Temporary packaging of categories

   a. If all of the matrix of a individual project is sorted

      - Review bone and separate into three categories:
      - 1. Broken pieces of the main bone (put aside for possible gluing);
      - 2. Identifiable bones (put into individual capsules or plastic containers);
      - 3. Unidentifiable bone fragments (put into one capsule or larger container).
      - Review plant material (separate seeds and put into capsule) and put into glass vial.
      - Review insect and put into one capsule.
      - Review shell and put into one capsule.

   b. If only a portion of the matrix is sorted

      - Place complete identifiable bones in capsules.
      - Place all bone fragments, plant, insect and shell into their own labeled containers.

When a large project is complete, all of the bone fragments must be reviewed and sorted to the above categories. It will be necessary to look at the small bone fragments under the microscope to determine the final number of Identifiable bones.

## Gluing

DO NOT GLUE UNTIL ALL MATRIX REMOVAL, POLISHING AND MATRIX SORTING IS DONE.

Use white glue for reconstructing most bones because it is reversible with warm water.

If a specimen is shattered, first reconstruct it holding the pieces together with masking tape. Do not glue until all of the fragments have been tested in available holes. Determine where all the major fragments go first and then glue from one direction. Have small strips of masking tape cut before the glue is applied. Apply glue with stick or dental pick in small amounts to the broken edges. Tape glued pieces in place and/or balance in sandbox for drying. Allow large pieces to dry overnight.

## Envelopes for finished projects

A copy of the original data must be made for every identifiable bone and one copy each for vial containing plant, insect, shell and unidentifiable bone. A rubber stamp template for "Found in assoc. w/" data is stamped on the face of a #5 ½ coin envelope. An exact copy of the original is then filled in. Note: Do not change the tentative field identification that is part of the original data even if it is wrong. The back of the envelope is stamped with a template for the scientific identification. If an "assoc. w/ bone "or the plant fragment is too large to fit inside an envelope, it should be put in a small plastic bag with an envelope. The envelopes are stapled shut and the entire project is put in one large plastic bag.

The finished bag should include the main bone, fragments of the main bone that could not be glued on, the original data and all the "associated with" specimens.

# Pre-Curation

After the specimens have been cleaned, the microfossils sorted and put into individual capsules and individual envelopes have been made for each specimen with all of the provenance data written on each envelope (see laboratory procedures) they are sent to the curation station. Identification of all of the fossils takes place near the comparative collection in the lab in order to facilitate identification. The principal measured out specimen with its original 3"x 5" field data card is identified first. The card is stamped on the back with a custom stamp with Scientific Name, Element, Identifier, and Notes. The specimen is identified as much as possible but identifications necessarily range from class identification such as Aves to genus and species. The identifier also describes the element according to an established list of bone terminology. Then each of the microfossils associated with that main bone are also identified in the same manner. After all of the microfossils that accompany that main specimen are identified, they are placed in a clear plastic bag with a twist tie and sent to the cataloging station. Below are detailed step-by-step instructions on how to identify specimens.

For each specimen follow the steps below in the order given.

1. Choose a specimen from the 'to be identified' box. If several envelopes are fastened together you must keep them together and complete the work on all of them.
2. Check the bone to see if it is clean and that all broken pieces have been glued if possible. If the bone is not clean then do not proceed with that one and send it back to the lab
3. Identify the bone using the reference collection and write the identification on the back of the envelope or card in pencil. Only use paperclips to join envelopes together.
4. Check to see if the main identified bone is in the original envelope or with the original 3" x 5" card.
5. Send identified specimen to be cataloged

- Always put the comparative bone back in the box it came from!
- if you find a 'found in association with' envelope which is not still with its original envelope, find the original envelope and fasten them together
- put all tools away and empty bags and containers

## Associated groups

If there is more than one specimen in an envelope the principal bone for which the measurements were recorded should remain in the original envelope. The other specimens should be treated as follows;

- all plants in one envelope
- all insects in one envelope
- all shells in one envelope
- each identifiable bone in a separate envelope, along with any of its broken pieces
- all unidentifiable bone in one envelope
- all difficult to identify bones in one envelope

Use envelopes stamped "Found in Association with" and make a complete copy of the information from the original envelope on each one.

## Identifiable and Unidentifiable Specimens

Identifiable bone characteristics:

- presence of an articular surface
- cross-sectional shape
- foramina
- distinctive curves
- relative size combined with other features

Bones are rated in three different grades of how easy they are to identify

- identifiable
- difficult to identify
- unidentifiable

Double check all identifications

## Identification of Specimens

The back of each envelope is marked with a custom stamp (stamp in bold below). Identifications are printed in pencil. An example below

- **Scientific name:** *Smilodon* (use both genus and species if more than one species)
- **Element:** prox. rt. tibia
- **Special Notes:** Pathology
- **Identifier:** ABF

1. Avoid using terms such as "frag" or "portion". Use prox. or dist. if appropriate.
2. You must not abbreviate scientific names but you may use abbreviations for the elements as long as they are the ones listed in this manual.
3. When identifying skulls and mandibles always list the teeth that are present and if they are erupting, fully erupted or worn.
4. The format of the identification is very important. Do not invert the word sequence e.g. prox. rt. rib is correct but rib, rt. prox. is not.
5. For incomplete bones name both the bone e.g. XIII thoracic vert and either the represented part e.g. centrum or the missing portion, e.g., w/o right transverse process. Make sure that the identity of the bone and its qualifier are both listed.
6. Be specific about the identity of any represented epiphysis, e.g., proximal or distal epiphysis of a limb bone, or head epiph of lt femur or ant cent epiph of thoracic vert.

7. Ordinal numbers of ribs, vertebrae, metapodials and digits are written in Roman numerals e.g. rt. II rib or XII thoracic vert

8. Number of phalanges and teeth are written in Arabic numerals e.g. 2nd phalanx or rt. M1. Note that abbreviations for upper molars are written in upper case letters (I, C, P, M) whereas those for lower teeth are written in lower case (i, c, p, m). For clarity of handwritten entries, put a line below the number for upper teeth (e.g. P4/) and a line above the number for lower teeth (e.g. m/1).

9. The side, either left or right comes before a number e.g. rt. II metatarsal

10. There are two special cases:

    - Phalanges that can be precisely named include sloth phalanges, carnivore 'thumb' phalanges and bird carpal phalanges e.g. rt. 1st carpal phalanx, digit I

    - Teeth which can be specifically named e.g. lt. p2

11. Skull fragments: if the facial or cranial region of the skull is mostly intact this can be recorded as 'ant' or 'post' skull. However if there are only a few fragments the individual bones are named e.g. basisphenoid, occipital and rt. temporal or indicate if some parts are missing, e.g. post. skull w/o rt. occipital.

12. Juvenile specimens: it is important to note if an epiphysis is missing as the order of ephiphyseal fusion is used to detect the age of an animal. Also mark "juv." in the special notes section of the identification.

## Abbreviations chart for elements

| | | |
|---|---|---|
| Left: lt. | Posterior: post. | With: w/ |
| Right: rt. | Ventral: vent. | Without: w/o |
| Proximal: prox. | Dorsal: dors. | Juvenile: juv. |
| Distal: dist. | Medial: med. | Pathological: path. |
| Anterior: ant. | Lateral: lat. | Unidentifiable: unid. |

Difficult to identify: diff.

Zygomatic: zygo.

Epiphysis: epiph.

Diaphysis: diaph.

Tuberosity: tub.

Trochanter: troch.

Articular: artic.

Vertebra: vert.

Transverse: trans.

Process: proc.

Centrum: cent.

Prezygapophysis: prezyg.

Postzygapophysis: postzyg.

Incisor: I (upper) or i (lower)

Canine: C (upper) or c (lower)

Premolar: P (upper) or p (lower)

Molar: M (upper) or m (lower)

Deciduous: D

## Dental formulae for Rancho La Brea fauna

Dental formulae are a short hand way of indicating the number and kind of teeth that are present. The upper jaw is indicated first and the teeth are in order: incisor, canine, premolar, molar.

Ruminant artiodactyls

0,0,3,3 / 3,1,3,3

*(Antilocapra, Bison, Capromeryx, Odocoileus)*

Camelids

*Camelops:* 1,1,2,3 / 3,1,1,3

*Hemiauchenia:* 1,1,2,3 / 3,1,1-3,3

Peccaries

*Platygonus:* 3,1,4,3 / 3,1,4,3

Horses

*Equus:* 3,1,3,3 / 3,1,3,3

Tapirs

*Tapirus:* 3,1,4,3 / 3,1,4,3

Dogs and bears

3,1,4,2 / 3,1,4,3

*(Arctodus, Canis dirus, Canis latrans, Urocyon, Ursus)*

Cats

3,1,3,1 / 3,1,2,1

*(Felis atrox: Felis concolor: Lynx)*

Sabertoothed cats

*Smilodon:* 3,1,2,1 / 3,1,1,1

Skunks, weasels, & badgers

3,1,3,1 / 3,1,3,2

- Tympanic bulla
- Vomer

Auditory ossicles

- Malleus
- Incus
- Stapes

**Mandible**

- Angular process
- Coronoid
- Articular condyle
- Symphysis

**Hyoid**

- Basihyal
- Epihyal
- Thyrohyal
- Ceratohyal
- Stylohyal

Teeth

- Permanent upper and lower. Upper denoted by upper case abbreviation and lower by lower case abbreviation.
    - Incisor – I (upper) or i (lower)
    - Canine – C (upper) or c (lower
    - Premolar – P (upper) or p (lower)
    - Molar – M (upper) or m (lower)
- Deciduous upper and lower. Upper denoted by upper case abbreviation and lower by lower case abbreviation.
    - Incisor – DI (upper) or di (lower)
    - Canine – DC (upper or dc (lower)
    - Premolar –DP (upper) or dp (lower)

**Vertebra (e)**

- Atlas
- Axis
- Caudal
- Centrum
- Cervical
- Lumbar
- Neural spine
- Odontoid process
- Postzygapophysis
- Prezygapohysis
- Sacral
- Sacrum
- Thoracic
- Transverse process
- Wing

**Ribs**

- Capitulum
- Shaft
- Tuberculum

**Sternum**

- Manubrium
- Sternebra
- Xiphisrernum

**Scapula**

- Acromium process
- Coracoid process
- Glenoid fossa
- Metacromion
- Spine
- Vertebral border

**Humerus**

- Deltoid tuberosity
- Entepicondylar foramen
- Greater tuberosity
- Head
- Lateral condyle
- Lateral epicondyle
- Lesser tuberosity
- Medial condyle
- Medial epicondyle

**Radius**

- Styloid process
- Radial tuberosity

**Ulna**

- Coronoid process
- Olecranon
- Semilunar notch
- Styloid process
- Radial notch

**Carpals**

- Cuneiform
- Trapezium
- Lunar
- Magnum
- Trapezoid
- Central
- Pisiform
- Unciform
- Radial sesamoid
- Scapholunar
- Scaphoid

**Metacarpal**

- Plantar tubercle

**Sesamoids**

- Proximal sesamoid
- Distal sesamoid

**Phalanges**

- 1st, 2nd, 3rd, 4th, 5th
- Carpal
- Tarsal

**Inominate**

- Acetabulum
- Iliac crest
- Ilium

- Ischial tuberosity
- Ischium
- Pubic symphysis
- Pubis

**Fabella**

- Lateral
- Medial

**Femur**

- Greater trochanter
- Head
- Lateral condyle
- Lateral epicondyle
- Lesser trochanter
- Medial condyle
- Medial epicondyle
- Neck
- Patellar track
- Third trochanter

**Patella**

**Tibia**

- Lateral condyle
- Medial condyle
- Medial malleolus
- Tibial tuberosity

**Fibula**

- Head
- Lateral malleolus
- Distal fibula (herbivore)

**Tarsals**

- Astragalus
- Calcaneum
- Cuboid
- Ectocuneiform
- Entocuneiform
- Mesocuneiform
- Navicular
- Sustentaculum
- Naviculocuboid

- Mesoectocuneiform

**Metatarsal**

- Plantar tubercle

**Non-articulating bones**

- Baculum (male)
- Dermal ossicle (sloth)
- Sclerotic ossicles (birds and lizards)
- Falciform (sloth)
- Tracheal ring (birds)
- Dermal scale (lizard)

**Variations for juveniles**

- Diaphysis – shaft of juvenile long bone
- Epiphysis – the unfused articular surfaces of juvenile bone

**Numbers**

- Ribs – roman numerals
- Metapodials – roman numerals
- Digits – roman numerals
- Phalanges – Arabic numerals—$1^{st}$, $2^{nd}$, $3^{rd}$, $4^{th}$, $5^{th}$, terminal

## Curation

In order to curate specimens into the collections of the George C. Page Museum, all of the above-mentioned steps for excavation, preparation, and identification must be followed. The field number, orientation measurements, and pertinent field notes and photographs are all integral parts of the specimen information and must be readily available. Each specimen will receive an individual catalog number that is first recorded in an archival catalog book and then entered into the electronic database EMu, which is stored on the Natural History Museum's server. Once cataloged, each specimen is stored taxonomically in the collections. Specimens are housed in metal or wooden drawers within standard metal Lane cabinets. On average each drawer holds about seventy five specimens and each cabinet contains nine drawers.

Based on a typical deposit for Project 23, a 1m X 1m x 25cm grid yields approximately 1000 macro-vertebrate specimens per one (1) cubic meter. Additionally each cubic meter can have up to 2000 micro-vertebrate fossils. A typical conical shaped deposit can be up to 30 cubic meters.

## Appendix A

Table 1. Anatomical codes used for orienting specimens in the 2- and 3-point measurement system.

| | |
|---|---|
| A -- Anterior | Px -- Proximal |
| P -- Posterior | Dt -- Distal |
| M -- Medial | Lt -- Left |
| L -- Lateral | Rt -- Right |
| D -- Dorsal | R -- Root |
| V -- Ventral | C -- Crown |

Table 2. Anatomical codes of osteologic points used for orienting specimens in the 3-point measurement system.

## MAMMALS

**Skull:**
- AP - Anterior Premaxillae
- OC - Occipital Condyles
- POP- Postorbital Process (Rt or Lt)

**Vertebra:**
- AC - Anterior Centrum
- ANS- Anterior Neural Spine
- NS - Neural Spine
- PC - Posterior Centrum
- TP - Transverse Process (Rt and Lt)

**Scapula:**
- AP - Acromion Process
- CP - Coracoid Process
- D - Dorsal
- PA - Posterior Angle
- V - Ventral

**Radius:**
- Dt - Distal
- Px - Proximal
- RT - Radial Tuberosity

**Innominate:**
- IC - Iliac Crest
- IS - Ischial Tuberosity
- PU - Anterior Pubic Symphysis

**Tibia:**
- Dt - Distal
- Px - Proximal
- TT - Tibial Tuberosity

**Calcaneus:**
- Dt - Distal
- Px - Proximal
- S - Sustentaculum

**Mandible;**
- A - Anterior
- CP - Coronoid Process
- P - Posterior

**Rib:**
- Dt - Distal
- GC - Greatest Curve
- Px - Proximal
- Tub- Tuberculum

**Humerus:**
- Dt - Distal
- LEP- Lateral Epicondyle
- MEP- Medial Epicondyle
- Px - Proximal

**Ulna:**
- CP - Coronoid Process
- Dt - Distal
- Px - Proximal

**Femur:**
- Dt - Distal
- FC - Fovea Capitis
- Px - Proximal

**Fibula;**
- Dt - Distal
- LM - Lateral Malleolus
- Px - Proximal

**Metapodial:**
- Dt - Distal
- PT - Plantar Tubercle
- Px - Proximal

## BIRDS

**Skull:**
Same as Mammals

**Vertebra:**
- NS - Neural Spine
- TP - Transverse Process (Rt and Lt)

**Mandible:**
Same as Mammals

**Sternum:**
- A - Anterior
- CA - Carinal Apex
- P - Posterior

# ATTACHMENT 3

# Attachment 3—Wilshire/Fairfax Station Construction. Paleontological Resources Extraction

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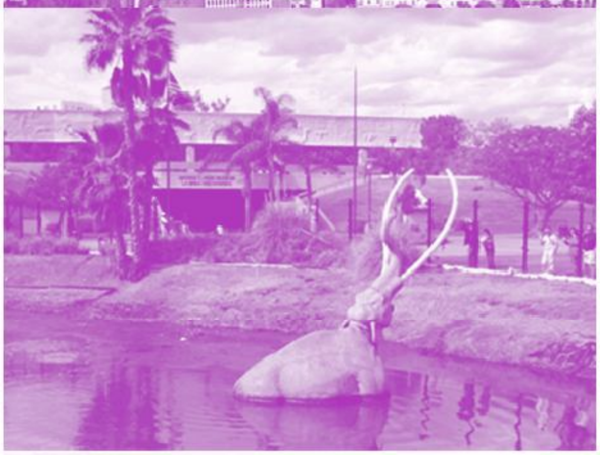


WESTSIDE SUBWAY EXTENSION PROJECT

# Wilshire/Fairfax Station Construction. Paleontological Resources Extraction.

Metro

December 2011

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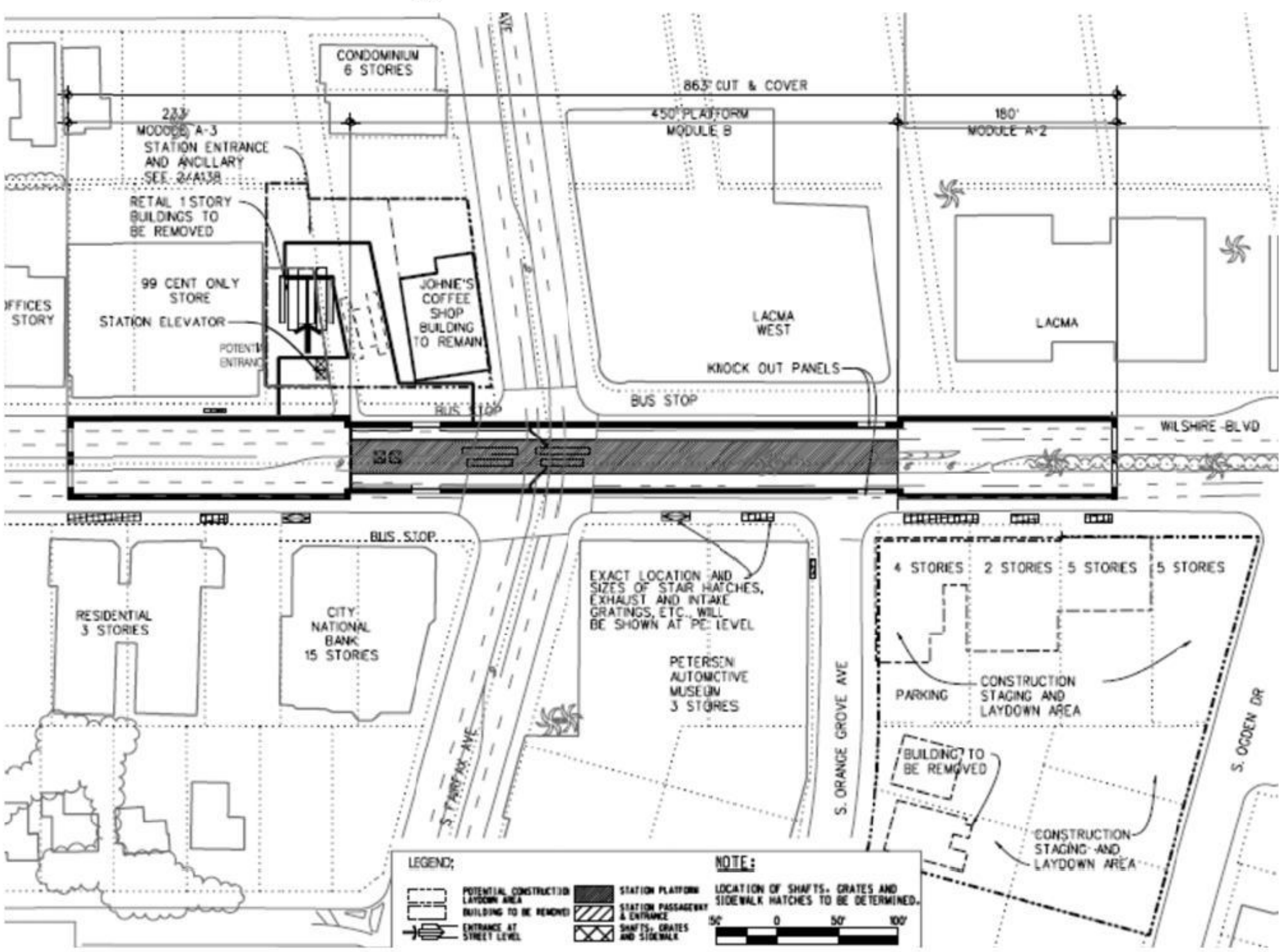
## Appendix

# 1.0 BACKGROUND

The Wilshire/Fairfax station box excavation will be approximately 860-ft long, 70-ft wide, and 60 to 70-ft below street level. The station extends beneath the intersection of Wilshire Boulevard and Fairfax Avenue - see Figure 1-1. The station entrance is planned to be located near the northwest corner of Wilshire and Fairfax between the 99 Cent Only Store and Johnie's Coffee Shop. Two alternative entrances under consideration; the south side of Wilshire between South Orange Grove Avenue and South Ogden Drive and; within the LACMA building at the north east corner of Fairfax Avenue and Wilshire Boulevard (May Company). A construction staging and materials laydown area is planned for the south side of Wilshire between South Orange Grove Avenue and South Ogden drive. Side access shafts will be located at the construction staging and materials laydown area and at the location selected for the station portal. The side access shafts will be excavated to the full depth of the station. The station box will be excavated by the cut and cover method and most probably use a temporary shoring system to support the excavation and decking system during construction, though a permanent shoring system that would be integrated into the permanent station structure could also be used. The side access shafts will be excavated by the open cut method and would most probably use the same type of shoring system that is used on the station box.

**Figure 1-1: Wilshire/Fairfax Station Box**



# 2.0 GEOLOGIC CONDITIONS

The geologic conditions in this region consist of soft alluvium deposits of sands, silty sand, clayey sand, gravely sand, silty clay, clayey silt, shell fragments, soil saturated with crude oil, and asphaltic (tar) sands. Several borings were taken within the station area; see Figure 2-1 through Figure 2-4. Core G-118 (Figure 2-1) was taken east of the station box between La Brea and Fairfax, the sample at 82-ft below ground surface (bgs) consists of silty clay/clayey silt with traces of crude oil. The portion of ring sample G-123 shown in Figure 2-2 is located just east of Fairfax at 60-ft bgs and consists of predominantly fine grained soil with channels of medium grained sand saturated with crude oil. Heavy tar was reported in G-123 from 38 – 110-ft bgs. Core sample G-124 (Figure 2-3 and Figure 2-4) was obtained just west of Fairfax by the Standard Penetration Test (SPT). The sample pictured was taken from 80-ft bgs and consists of medium to coarse grained sand saturated with tar. Heavy tar was reported in G-124 from 45 – 105-ft bgs. The consistency of tar in this region ranges from dry and hard to wet and oozing. This reach is also known to contain pockets of pressurized gases and dissolved gases in groundwater. The groundwater conditions are measured to have a water table depth of 74-ft bgs, and zones of perched water between 10 – 50-ft bgs. Since the station box invert depth will be located between 60 – 70-ft bgs, perched water can be anticipated during excavation.

**Figure 2-1: Core Sample G-118**

**Figure 2-2: Core Sample G-123**

**Figure 2-3: Core Sample G-124 (1 of 2)**

**Figure 2-4: Core Sample G-124 (2 of 2)**

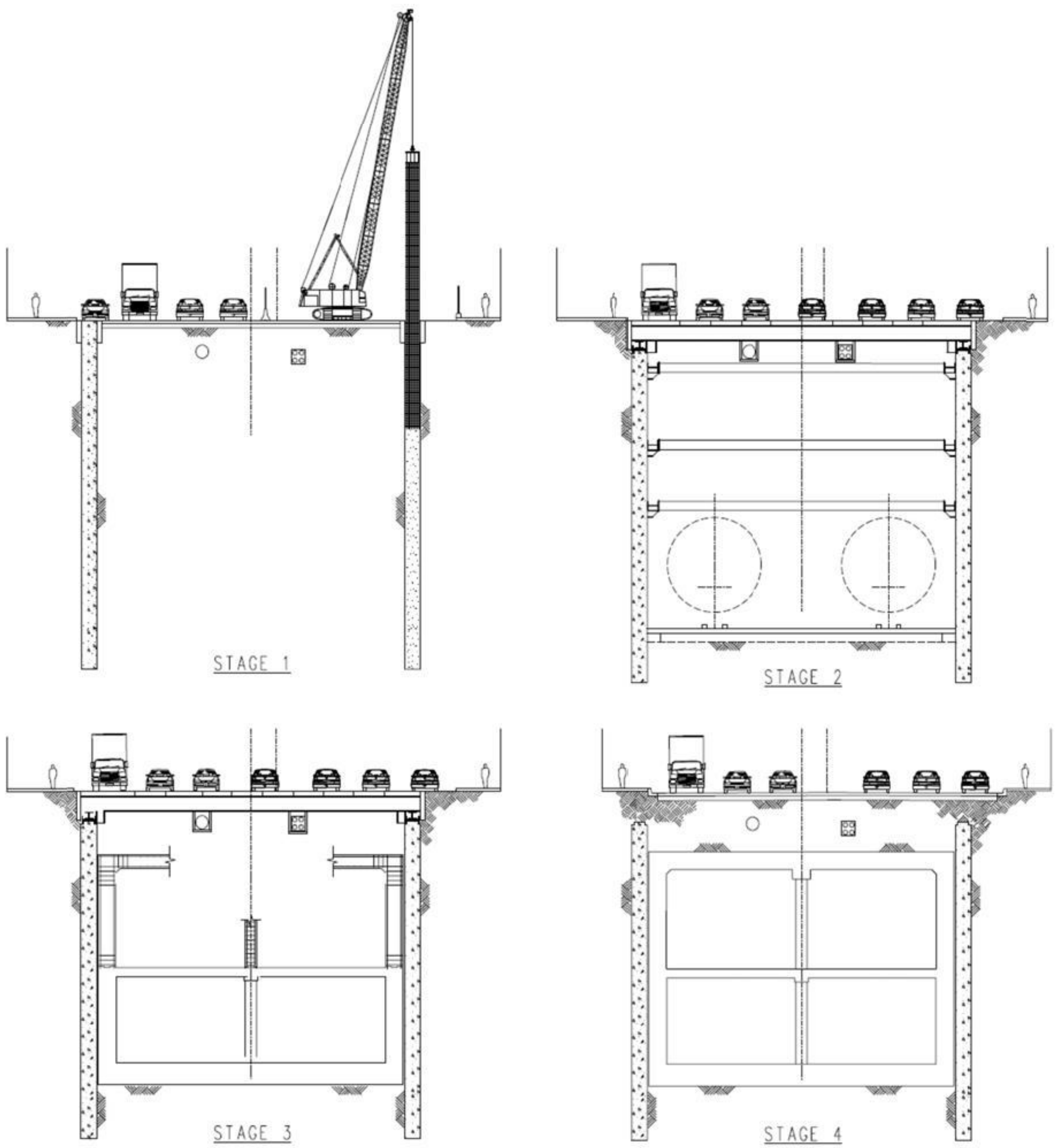
## 2.1 Gassy Ground Conditions

The gases present in the soils of this region are methane ($CH_4$) and hydrogen sulfide ($H_2S$). They are likely to occur in pressurized pockets as well as in a dissolved state in groundwater. These gases can seep into tunnels and other excavations through soil and also through discontinuities (fractures, faults, etc.) in bedrock. $CH_4$ and $H_2S$ are considered hazardous gases due to their explosive properties. $H_2S$ is also highly toxic. Being heavier than air, it tends to accumulate at the bottom of poorly ventilated spaces. Although very pungent at first, it quickly deadens the sense of smell, so potential victims may be unaware of its presence. $CH_4$ is extremely flammable and may form explosive mixtures with air. It is odorless and lighter than air, and it dissipates quickly once at the surface causing no threat of explosion. However, in 1985 an explosion occurred at the Ross Dress-for-Less in the Fairfax area which resulted in injuries requiring hospital treatment of twenty-three people. The explosion took place in a poorly ventilated ancillary room of the building where $CH_4$ gas had accumulated. There was no gas detection equipment at this location.

# 3.0 EXCAVATION SUPPORT TECHNIQUES

Cut and cover excavation is the preferred technique to excavate the station box structure, although cut and cover still leads to lengthy occupation of streets with noise disturbances and interrupted access (see Figure 3-1). Traffic interruptions can be mitigated by performing most excavation below a temporary decking system constructed at an early stage (See Figure 3-2 through Figure 3-6).

**Figure 3-1: Open Cut Excavation**



Shoring the excavation walls and providing structural support beneath the decking system can be accomplished through a variety of excavation support techniques. The following sections describe several excavation support methods, including: soldier pile and lagging, slurry walls, tangent piles, secant piles, and deep soil mix walls.

**Figure 3-2: Initial Excavation at Soto Station**


**Figure 3-3: Precast Concrete Decking**


**Figure 3-4: Installation of Decking (1 of 2)**

**Figure 3-5: Installation of Decking (2 of 2)**

Figure 3-6: Roadway Operations Restored on Temporary Decking System

## 3.1 Soldier Piles and Lagging

Soldier pile and lagging walls are a type of shoring system typically constructed along the perimeter of excavation areas to hold back the soil around the excavation. This support system consists of installing soldier piles (vertical structural steel members) at regular intervals and placing lagging in between the piles to form the retaining structure. Pre-augering is necessary for installation of the soldier piles. Pre-augering involves drilling holes for each pile from the street surface to eliminate the need for pile driving equipment and thereby reduces project noise and vibration levels that would otherwise occur while pile driving. Pre-augering also provides better accuracy of location than pile driving. The lagging, which spans and retains the soil between the piles, is typically timber or shotcrete (sprayed-on concrete) and is installed in a continuous downward operation taking place concurrently with excavation. The installation of soldier piles and lagging is a relatively clean process. The majority of construction materials, such as, drilled earth spoils, concrete, backfill, and H-piles are easy to contain within the construction site. The soldier piles and deck beams are installed first with excavation and lagging installation taking place from beneath the street decking. A soldier piles and lagging earth retention system is shown in Figure 3-7 through Figure 3-9. The equipment required for installation of the soldier piles includes drill rigs, concrete trucks, cranes, and dump trucks.

Soldier piles and lagging are generally used where groundwater inflow is not a consideration, or where grouting, or lowering of the groundwater level (dewatering) can be used to mitigate water leakage between piles. Based on findings from core samples, the geologic conditions in this area consist of soils containing deposits of oil and tar. Where these deposits occur along the excavation perimeter, oil or tar may tend to seep between the joints in the lagging. This is not considered to be a hazard to workers, although some cleanup may be necessary. Alternatives to soldier pile and lagging walls being considered for this station include tangent pile or secant pile walls, slurry walls, and deep soil mix walls (see next sections below).

**Figure 3-7: Pre-augering for Soldier Pile**


**Figure 3-8: Cut and Cover with Soldier Pile and Lagging**

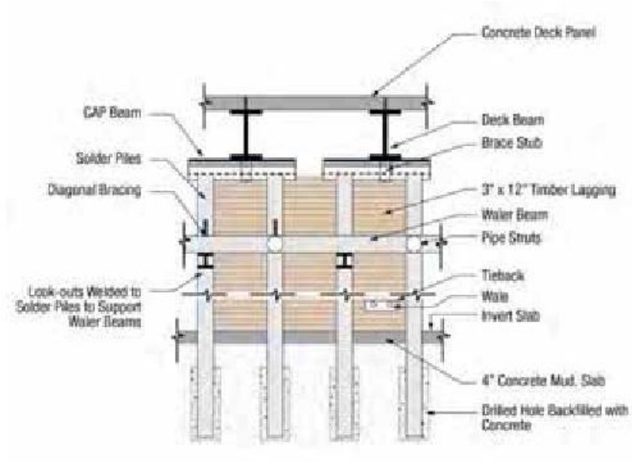
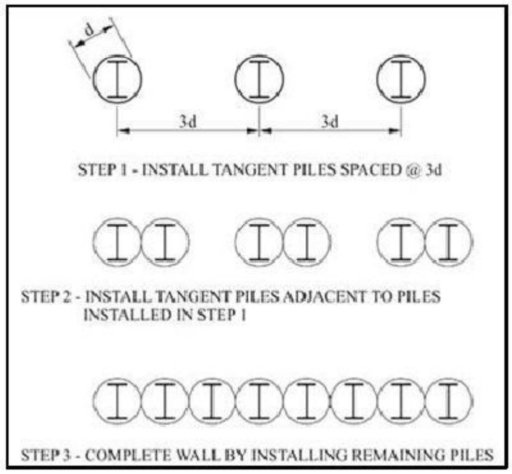



**Figure 3-9: Soldier Pile and Lagging**

## 3.2 Tangent Pile or Secant Pile Walls

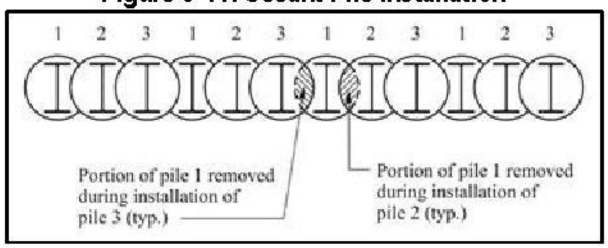
Figure 3-10: Tangent Pile Installation




Tangent pile walls consist of contiguous cast-in-drilled-hole (CIDH) reinforced concrete piles – see Figure 3-10. The contiguous wall generally provides a better groundwater seal than the soldier pile and lagging system, but some grouting or dewatering could still be needed to control leakage between piles.

A secant pile wall system is similar to the tangent pile wall but the piles have some overlap, facilitating better water tightness and rigidity - see Figure 3-11. This method consists of boring and concreting the primary piles at centers slightly less than twice the pile diameter. Secondary piles are then bored in between the primary piles, prior to the concrete achieving much of its strength.

Figure 3-11: Secant Pile Installation




In terms of relative cleanliness, tangent pile and secant pile walls are comparable to one another and both are more difficult to contain than soldier piles and lagging due to the greater amount of pumped concrete and the expected larger diameter of drilled holes. The completed secant pile wall for the Barnsdall Shaft in Hollywood for the Metro Red Line project is shown on Figure 3-12. Secant and Tangent pile shoring systems are slower to construct that soldier pile and lagging and therefore have the disadvantage of requiring longer lane closures on Wilshire while they are being constructed. Furthermore, because of the close spacing of tangent piles, utilities crossing the wall often require relocation whereas a soldier pile system can often be built around the existing utilities. The equipment required for installation of the tangent pile or secant pile walls includes drill rigs, concrete trucks, cranes, and dump trucks.

Figure 3-12: Secant Pile Wall at Barnsdall Shaft on Metro Red Line

## 3.3 Diaphragm/Slurry Walls

Diaphragm walls (commonly known as slurry walls) are structural elements used for retention systems and permanent foundation walls. Use of slurry wall construction can provide a nearly watertight excavation, eliminating the need to dewater. Slurry walls are constructed using deep trenches or panels which are kept open by filling them with a thick bentonite slurry mixture. After the slurry filled trench is excavated to the required depth, structural elements (typically a steel reinforcement cage - see Figure 3-13) are lowered into the trench and concrete is pumped from the bottom of the trench, displacing the slurry. Figure 3-14 and Figure 3-15 illustrate slurry wall excavation equipment.

Figure 3-13: Steel Reinforcement Cage for Slurry Wall

Tremie concrete is placed in one continuous operation through one or more pipes that extend to the bottom of the trench. The concrete placement pipes are extracted as the concrete fills the trench. Once all the concrete is placed and cured, the result is a structural concrete panel. Grout pipes can be placed within slurry wall panels to be used later in the event that leakage through wall sections, particularly at panel joints, is observed. The slurry that is displaced by the concrete is saved and reused for subsequent panel excavations.

Slurry wall construction advances in discontinuous sections such that no two adjacent panels are constructed simultaneously. Stop-end steel members are placed vertically at each end of the primary panel to form joints and guides for adjacent secondary panels. In some cases, these members are withdrawn as the concrete sets. Secondary panels are constructed between the primary panels to create a continuous wall. Panels are usually to full depth and 8 – 20-ft long and vary from 2 – 5-ft wide.

Figure 3-14: Slurry Wall Construction Equipment

Figure 3-15: Clamshell Digger for Slurry Wall Construction

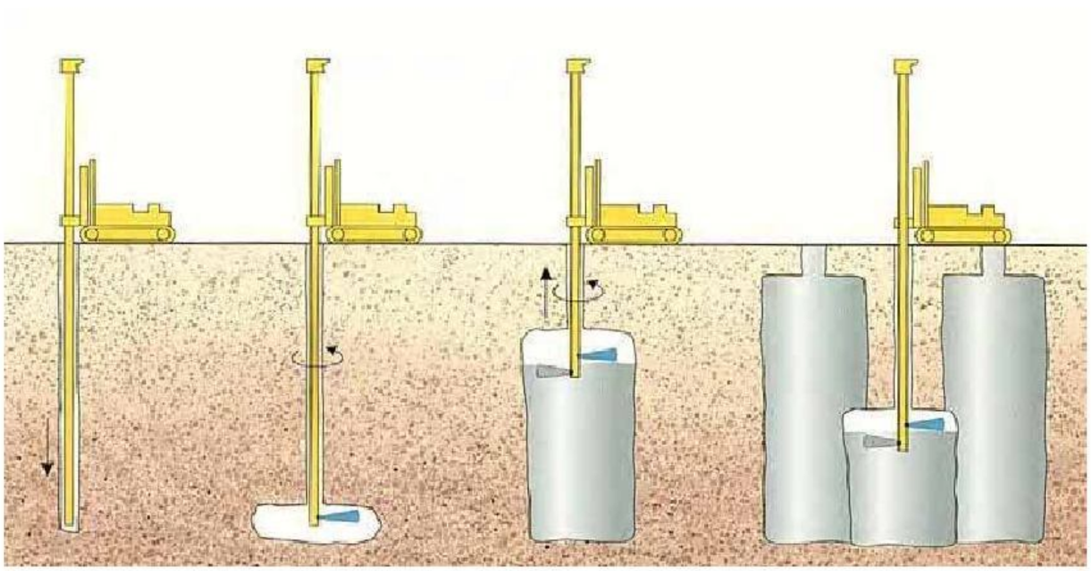
Similar to other shoring systems, slurry wall construction would occur in stages, working on one side of the street at a time. These walls have been constructed in virtually all soil types to provide a watertight support system in addition to greater wall stiffness to control ground movement. Because slurry walls are thicker and more rigid than many other shoring methods, the walls may in some cases be used as the permanent structural wall, although this application is not anticipated for this project. Where slurry walls are used, the thickness of the permanent structural walls can sometimes be reduced, i.e. when compared to wall thicknesses used with a conventional soldier pile and lagging system after removal of internal bracing.

Slurry wall construction materials are the most difficult to contain within the construction site of all the shoring types being considered due to the inherent messy nature of bentonite slurry combined with the operational characteristics of the clamshell digger which will likely be used to excavate large volumes of soil from the wall trench. Slurry walls are generally not adaptable to utility crossings and all utilities crossed by the wall would require temporary or permanent relocation. The equipment required for installation of the slurry walls includes clamshell or rotary head excavators, concrete trucks, slurry mixing equipment, cranes, slurry treatment plant, and dump trucks. The bentonite slurry would require disposal after a number of re-use cycles. Slurry walls are also slow to construct and will be very disruptive to traffic on Wilshire Boulevard.

## 3.4 Deep Soil Mix Walls

Deep soil mix walls are another type of temporary or permanent shoring system for deep excavation. Mechanical soil mixing is performed using single or multiple shafts of augers and mixing paddles. See Figure 3-16. The auger is rotated into the ground and slurry is pumped through the hollow shaft feeding out at the tip of the auger as the auger advances. Mixing paddles blend the slurry and soil along the shaft above the auger to form a soilcrete mixture with high shear strength, low compressibility, and low permeability. Spoils come to the surface comprised of cement slurry and soil with similar consistency to what remains in the ground. Steel beams are typically inserted in the fresh mix to provide structural reinforcement. A continuous soil mix wall is constructed by overlapping adjacent soil mix elements. Similar to secant pile walls, soil mix elements are constructed in alternating sequence; primary elements are formed first and secondary elements follow once the first have gained sufficient strength.

**Figure 3-16: Deep Soil Mix Construction**



Deep soil mix wall construction materials are also difficult to contain. Most of the construction process is performed by a single piece of equipment which mixes cement and soil in situ. Cement and soil mixture can be expected to escape beyond the confines of the drilling operation creating problems for traffic and pedestrians. The equipment required for installation of deep soil mix walls includes multi-shaft drill rigs, concrete trucks, cranes, and dump trucks.

## 3.5 Comparison of Excavation Support Techniques

Due to the speed of construction, and the ability to work around utilities, soldier piles and lagging is preferred unless site conditions dictate the use of other methods. See Table 3-1 for a comparison of excavation support methods. Soldier piles and lagging is the predominant shoring system used in the Los Angeles area and has been used successfully by Metro on construction of both Red and Gold Line stations. Experience at the LACMA parking garage excavation suggests that soil off-gasses immediately after being exposed but with a short period of time, the off gassing slows to levels acceptable for work. This suggest that the relatively impervious seal achieved by slurry walls, secant piles, and deep soil mix walls may only provide very short term benefits and that gas entering the station box excavation through a soldier pile and lagging system could be controlled with a well designed ventilation system.

Since it is anticipated that gassy soils will be encountered regardless of shoring system type, various methods of providing a safe and hazard free workplace will be implemented in all situations. No matter which type of temporary shoring system is selected; other measures such as, partially open decking, ventilation, gas detection, and Personal Protective Equipment (PPE), will be in use to protect workers from gases that may enter the excavation site.

**Table 3-1: Comparison of Excavation Support Types**

| Shoring Method | Permeability | Installation Duration | Containment Impacts | Noise / Vibration Impacts | Traffic Impacts | Utility Impacts | Business Impacts |
|---|---|---|---|---|---|---|---|
| Soldier Pile & Lagging | High | concurrent w. excavation | Low | Moderate | Moderate | Moderate | Moderate |
| Slurry Wall | Low | 3 Months | High | Moderate | High | High | High |
| Secant Pile | Low | 3 Months | Moderate | Moderate | High | High | High |
| Tangent Pile | Moderate | 3 Months | Moderate | Moderate | High | High | High |
| Deep Soil Mix | Low | 3 Months | Moderate | Moderate | High | High | High |

## 3.6 Construction Staging

For all types of shoring, the contractor would first occupy one side of the street to install one line of excavation support piles or wall panels. The installation will require extended closures of 2 – 3 traffic lanes on the side of the street where the equipment would be staged. After installation of piles or walls on both sides of the street at the station excavations, piles or walls would then be installed across the street at the station ends. This operation would also require lane closures, and is often done during night-time or weekend periods. The contractor would then proceed with installation of deck beams, installation of the deck panels and excavation and bracing. Deck panels (decking) allow continued traffic and pedestrian circulation since they will typically be installed flush with the existing street or sidewalk levels though raised decking, which requires less excavation during installation is being discussed with the traffic authority. Raised decking does have particular advantages at Wilshire / Fairfax Station as less excavation during the weekend closures while installing the decking makes it less likely that fossils will be encountered during the decking operation.

Deck installation will require successive full road closures on weekends with traffic detours. The decking would be installed in stages, commensurate with the amount of decking that can be installed during a weekend closure. Typical decking installation rates range from 50 -100 ft / weekend for an installation crew. Multiple crews will be used wherever possible to reduce the number of full road closures

## 3.7 General Approach to Handling Utilities

Prior to beginning construction of shoring and decking, it will be necessary to relocate, modify or protect in place all utilities and underground structures that would conflict with excavations. The contractor will verify locations through potholing methods and where feasible, the utility will be relocated so as to stay out of station or other surface structure excavation. Where the utility cannot be relocated outside the excavation footprint, it will be exposed and hung from the supporting structure (deck beams) for the roadway decking over the cut-and-cover structure. See Figure 3-17 and Figure 3-18.

**Figure 3-17: Utilities Hung from Deck Beams**

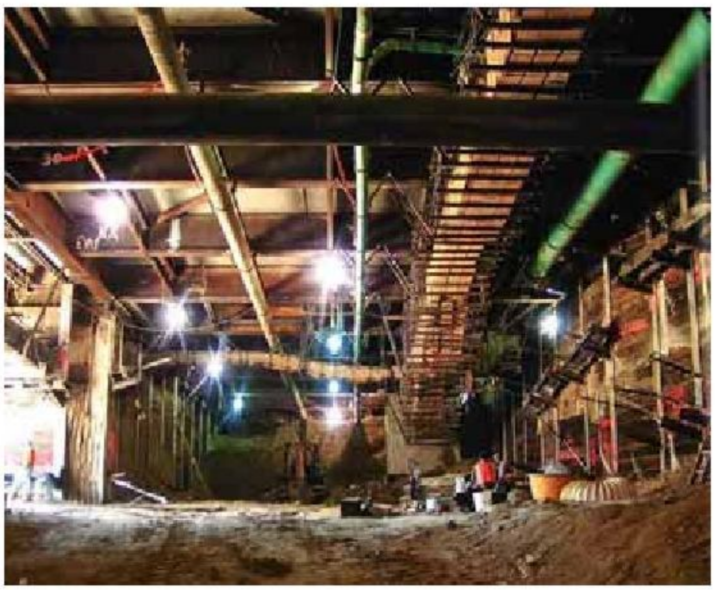
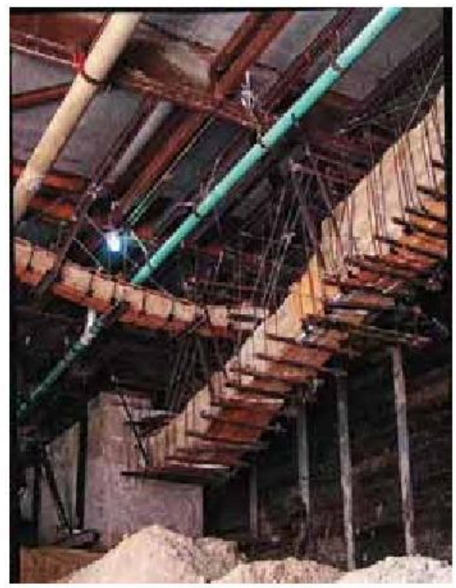


**Figure 3-18: Utilities Hung from Deck Beams (Close Up)**



Shallow utilities, such as maintenance holes or pull boxes, which would interfere with excavation work, will require relocation. The utilities alignments will be modified and moved away from the proposed facilities. Utility relocation takes place ahead of station and other underground structure excavation. During this time, it will be necessary to close traffic lanes.

It is possible that in some instances, block-long sections of streets would be closed temporarily for utility relocation and related construction operations. Pedestrian access (sidewalks) would remain open and vehicular traffic would be re-routed. Temporary night sidewalk closures may be necessary in some locations for the delivery of oversized materials. Special facilities, such as handrails, fences, and walkways will be provided for the safety of pedestrians.

Minor cross streets and alleyways may also be temporarily closed but access to adjacent properties will be maintained. Major cross streets would require partial closure, half of the street at a time, while relocating utilities.

**Figure 3-19: Backfilling Utilities in Final Location beneath Road Surface**

Utilities, such as high-pressure water mains and gas lines, which could represent a potential hazard during cut-and-cover and open-cut station construction and that are not to be permanently relocated away from the work site, would be removed from the cut-and-cover or open-cut area temporarily to prevent accidental damage to the utilities, to construction personnel and to the adjoining community. These utilities would be relocated temporarily by the contractor at the early stages of the operations and reset in essentially their original locations during the final backfilling above the constructed station. See Figure 3-19

# 4.0 PALEONTOLOGICAL ISSUES

The Wilshire/Fairfax Station is situated within the vicinity of the Hancock Park Rancho La Brea Tar Pits. The San Pedro Sand layer exists beneath the older and younger alluvium deposits near the surface in this region. This formation has a high likelihood for producing significant paleontological resources. The existing La Brea Tar Pits immediately adjoining the Wilshire/Fairfax Station site is the largest collection of fossils of extinct mammals in the entire world. Because of the high likelihood of fossil discovery while excavating the Wilshire/Fairfax station box, station construction at Wilshire/Fairfax will be given the maximum time available within the overall project schedule, so that excavation can proceed slowly and carefully and fossils located and removed without schedule pressures.

Before fossil recovery can begin, utility relocation and shoring for the station excavation using one or more of the shoring methods outlined above must occur. Utility relocations, by their nature (narrow trenches beneath paved streets) will make recovery of fossils during this phase of the work unlikely. Then, any fossils that lie within the footprint of the shoring will necessarily be destroyed when the shoring is constructed, as there is no way to remove them in advance of the shoring. However, shoring will at worst occupy less than 10% of the footprint of the station excavation, leaving 90% of the footprint unaffected and suitable for fossil recovery.

The plan for fossil removal has been based on the methods used by the Page Museum for the removal of fossils from the nearby LACMA parking garage excavation, referred to from here-on by the Page Museum name, Project 23. The ground will be excavated in shallow lifts, with museum staff on land to inspect the excavated surfaces as earth is removed and to mark the locations of fossils when discovered. It is assumed that the fossils will occur in a manner similar to that at Project 23, i.e. concentrated in vertical tar “pipes” which, once located, can be boxed in place and then removed from the site for further analysis. As with Project 23, fossils can also be found away from the tar pipes so all excavated surfaces must be inspected, and the contractor’s team must be alerted to the possibility of finding fossils anywhere with the excavation. The Project 23 site was an open excavation, not constrained by a deck at ground level. This made boxing and removal of the fossil boxes a good deal more straight-forward than will be the case at Wilshire/Fairfax. Figure 4-1 shows fossils in a pit at the Page Museum, and Figure 4-2 a boxed “pipe” containing fossils being prepared at the Project 23 site. Figure 4-3 and Figure 4-4 show examples of fossils recovered from Project 23 after processing.

**Figure 4-1: Tar Deposit Containing Fossils**

**Figure 4-2: Fossil Box Construction at Project 23**

Figure 4-3: Smilodon (Sabre Tooth Cat) Pelvic Bone

Figure 4-4: Smilodon Skull in Fossil Box

## 4.1 Minimize Excavation Done Before Decking Installation

Although the Project 23 experience suggests that fossils will mainly be 10 ft or more below street level, fossils must be anticipated anywhere within undisturbed ground. Using the cut and cover excavation technique, deck beams which support the deck panels are installed in the road bed after the piles or shoring walls are complete. The top of the deck beams sit just below the roadway surface so that the decking is flush with the roadway. The deck beams are approximately 6-ft tall and joined together with cross bracing so a minimum of 7-ft of excavation is required for their installation. On Red line and Gold Line stations, contractors have normally excavated 10 ft deep when installing the deck beams to provide clear space beneath the beams for better access when commencing to dig out from beneath the decking and to expose utilities immediately below the deck beams.

Because the street decking requires a full street closure to install, only limited times are available in which to close the street. Full street closures, especially along Wilshire Boulevard will be limited to approximately 52 hours duration on week-ends, and this will not provide time to carefully remove soil in layers to expose fossils nor to box and remove any fossils found in this initial excavation. Therefore, opportunities for fossil recovery from the initial excavation for the street decking will be limited. It therefore requires a construction approach to try and reduce the depth of the initial excavation. Two strategies are being pursued in this regard. One approach is to use raised decking so that the bottoms of the deck beams can be raised up by the same height that the station decking is installed above street level. Metro is in discussions with traffic authorities regarding the acceptability of using raised decking at Fairfax. See Appendix A for details of raised decking. The other approach is to use shallower deck beams, either for a flush deck system or in conjunction with a raised decking approach. Shallower beams will almost certainly require installing the deck beams at closer centers, probably 7 ft centers instead of the usual 14 ft centers but the shallow beams will reduce the likelihood of finding fossils during decking.

It should be noted that many utilities in the street are much deeper than the bottom of the deck beams, and any fossils would have been destroyed during the construction of such utilities. Utilities already have disturbed a significant percentage of the station excavation footprint, and this will increase with the relocations required prior to the installation of the shoring and decking. Nevertheless, there will remain areas of undisturbed soil within the 10 ft immediately below street level and fossils therefore could be found in these locations. These areas can be mapped in advance so that they can be excavated carefully.

## 4.2 Excavation of the topmost layers beneath the street decking

Once the street decking has been installed, excavation beneath the decking will commence. The side access shaft(s) from the contractor's laydown area (see Figure 4-5) and from the station portal site will be excavated in shallow lifts, using methods similar to those of Project 23. Any fossils found will be removed. Once the side access shafts are deep enough to allow equipment to commence digging beneath the street decking, equipment will be lowered into then shaft to commence digging. One scenario will be for the contractor to dig the initial lift by scraping down the face, using low headroom equipment such as a Gradall (see Figure 4-6) or other equipment acceptable to Metro and to the Page Museum. The working face would be inclined at probably a 2:1 slope and would be accessible for inspection (see Figure 4-7). The excavation would proceed in this manner until the first lift was completely removed. The height of the first lift will be determined by the head room needed by the equipment needed for the subsequent lifts, but probably of the order of 12-14 ft. depending on the equipment selected, subsequent lifts could continue to be inclined or horizontal. Fossils and tar pipes containing fossils would be removed under the supervision of Page Museum staff, probably using the boxing techniques developed for Project 23. Because the Fairfax Station will be decked, handling large boxes beneath the decking will be very difficult. Boxes of not more than 500 cubic ft (approximately 30 tons) are proposed as an upper limit, and smaller boxes for the first lift below the decking may be necessary so that low headroom equipment will be able to carry the boxes back to the side access shaft. Actual box sizes can be determined in the field by the contractor and paleontologists. Figure 4-7 and Figure 4-8 show the proposed excavation sequence.

**Figure 4-5: Open Cut Excavation of Side Access Shaft**

**Figure 4-6: Gradall Excavator - East Side Access Project NYC**

**Figure 4-7: Cross Section Showing Excavation Procedure of Shallow Lifts at 2:1 (Approx) Slope Beginning from the Side Access Shaft**

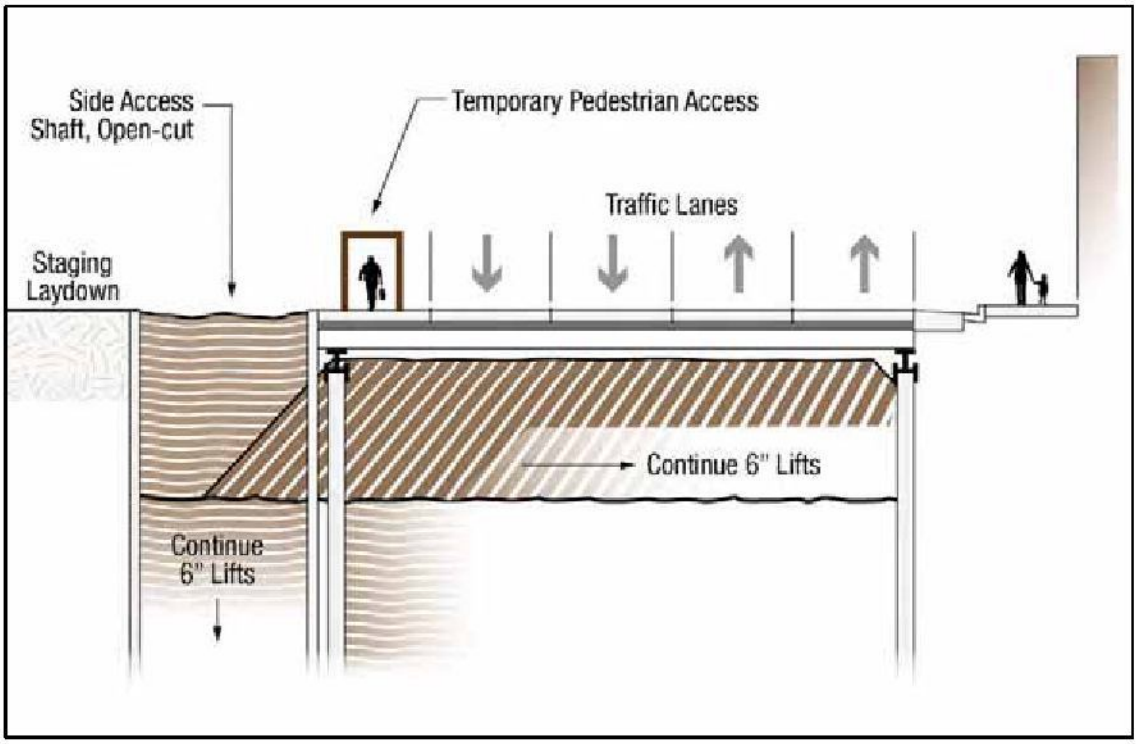
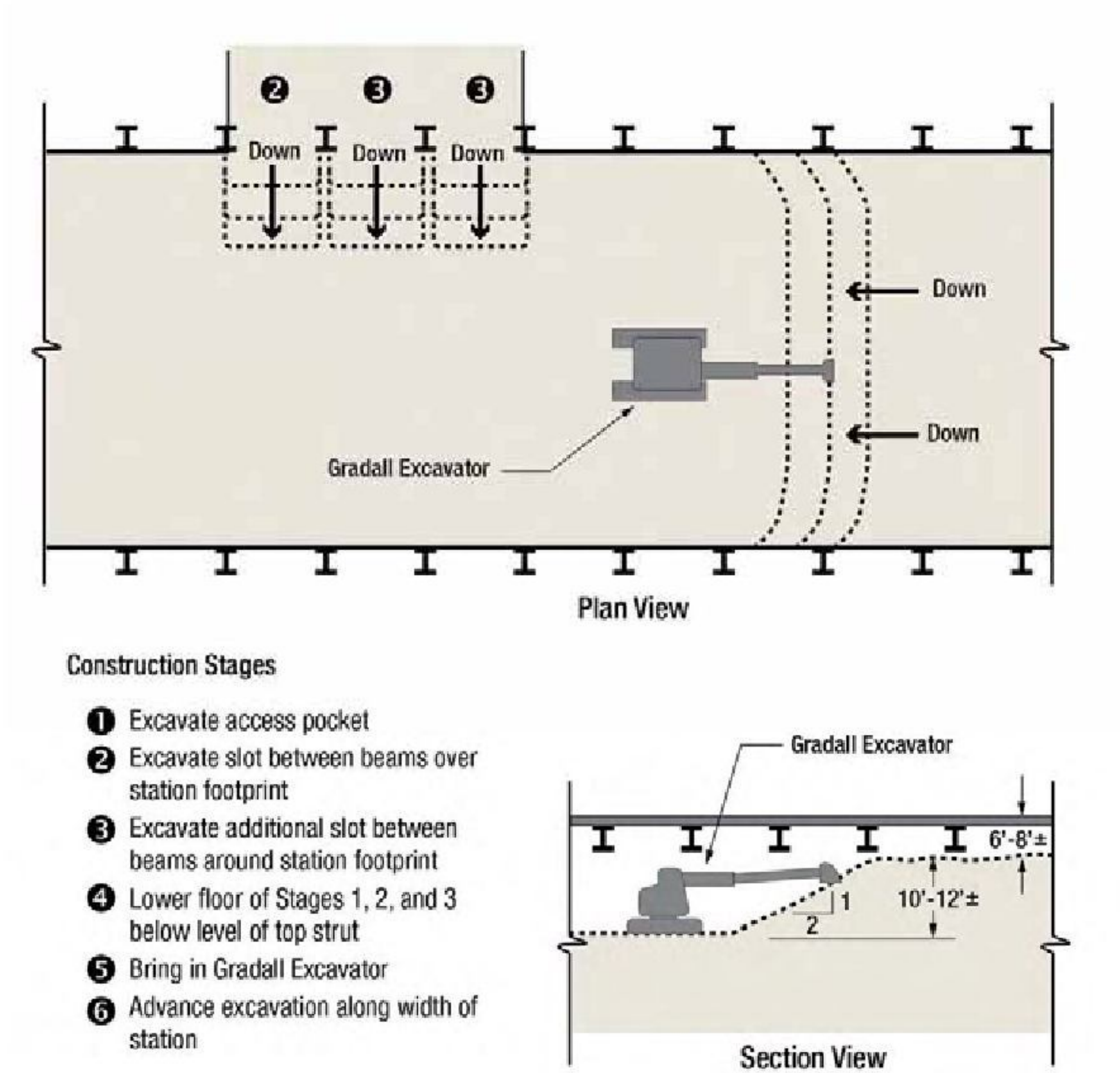


**Figure 4-8: Plan Showing Excavation Procedure of Shallow Lifts with Low-Profile Gradall Excavator**



## 4.3 Excavate in Layers

The station box and side access shafts will be excavated in shallow lifts to carefully expose and locate fossils. The Page Museum is suggesting 6” lifts based on experience at the Los Angeles County Museum of Art (LACMA) parking garage. As with Project 23, fossils can also be found away from the tar pipes so all excavated surfaces must be inspected, and the contractor’s team must be alerted to the possibility of finding fossils anywhere with the excavation.

Compact track loaders and compact excavators (see Figure 4-9 and Figure 4-10) are likely necessary for initial soil removal directly beneath the deck beams due to their low vertical clearance, and relatively small bucket size capable of excavating precise lifts. Continuous tracks improve vehicle traction on soft and sticky terrain and reduce the amount of pressure exerted on the soil below. A pressurized although this may not be an option due to tight clearances and proper ventilation will still be needed regardless. If soil conditions permit, a rubber tire vehicle like skid steer loaders or equipment fitted with floatation tires may be used instead of compact track loaders. Gradalls operate a bucket at the end of a telescopic arm in a linear motion. The linear shoveling motion enhances depth control improving the ability to cut in precise shallow lifts. These will be considered considered as well. Track loaders, wheeled dozers and hydraulic excavators would be employed to remove the bulk of the soils in order to maintain efficiency in excavating (see Figure 4-11 through Figure 4-13. Excavation with these tools will require careful observation to identify the location of tar deposits. When tar deposits are located, smaller equipment should step in to avoid damaging fossil resources with heavier machines.

**Figure 4-9: Compact Track Loader**

**Figure 4-10: Compact Excavator – 6.75’-Tall/12’-Long/6.5’-Wide**

It is possible that the discovery and removal of fossils could lead to schedule delays and the station box structure would not be completed in time to precede the TBM breakthrough. As long as station box excavation has not breached a reasonable depth above where the top of the tunnel liner will be so that it would compromise the operation of the TBM, then the TBM drive should continue through the station box location and station excavation would work its way down and eventually break through the tunnel liner.

**Figure 4-11: Tracked Loader Removing Muck from Beneath Struts**

**Figure 4-12: Hydraulic Excavator between Struts**

**Figure 4-13: Track Loader beneath Struts**

It may be possible to use an imaging technique to locate fossils ahead of excavating operations thus allowing the pace of excavation to accelerate beyond the recommended 6" lift limit. If the imaging technique produces a reliable indication, the boxing of fossils can be pre-planned. Some techniques of scanning for objects below the surface that should be considered are Ground Penetrating Radar (GPR), HAARP Detection using ELF and VLF radio waves, electrical resistivity imaging, and geophysical diffraction tomography.

If an Early Work Authorization is obtained, construction can begin on an exploratory shaft to test the effectiveness of the anticipated geophysical methods. The shaft could be located within the limits of a side access shaft and would ideally reach full station depth in order to learn as much as possible from this process. The length and width of the shaft should be a minimum size to allow a variety of the equipment under consideration to perform excavation operations during the exploration process. Construction methods will be tested to determine the best techniques and tools for station box excavation. Shoring types will be tested to determine the effectiveness of the planned shoring in the soils present in the area. Gas levels will be measured to gauge the specifics of the ventilation scheme.

## 4.4 Fossil Box Size

As layers of soil are removed, tar-laden sand deposits containing fossils are likely to be uncovered. When this happens, work is halted within proximity of the fossil to allow the paleontologists on site to assess the discovery and begin preparations for boxing and removal of the deposit. The technique of boxing and removing fossil deposits to an off-site facility for additional paleontological work is an efficient process that was first implemented at the La Brea Tar Pits in 1915 and more recently during the construction of Project 23. A photo of the 1915 boxing method is contained on Page 8 of Rancho La Brea, Death Trap and Treasure Trove, Edited by John M. Harris, June 2001.

**Figure 4-14: Fossil Boxes at Project 23**

The box construction technique used on Project 23 is similar to that which is used for boxing palm trees for transport. See Figure 4-14. First, the paleontologist defines the location of the fossil deposit. Next, trenches are dug around the sides and excavation continues by removing sterile soil from around the fossil zone with heavy equipment leaving an island where the deposit sits. The bottom of the box is most challenging. After the box is supported by blocks and shims at each of the four corners, workers must crawl beneath the box and dig by hand while inserting the timber boards which make up the base of the box (Figure 4-15). An alternative approach to creating the bottom of the box which would improve worker safety and expedite the excavation process would require an auger to drill holes in the island beneath the fossil deposit. Timbers would be inserted through the auger holes, thus beginning to form the base of the box. The auger would then remove the balance of soil between the timbers allowing completion of the box and freeing the deposit from the soil below. See Figure 4-16. During the excavation of Project 23, sixteen tar deposits were discovered. From the sixteen deposits, twenty-three boxes were recovered, thus giving the parking garage project its name. The boxes range in size from 5x5x5-ft (weighing 3 tons) to 12x15x10-ft (weighing 56 tons).

**Figure 4-15: Fossil Relocation Process. (From Page Museum Whiteboard)**

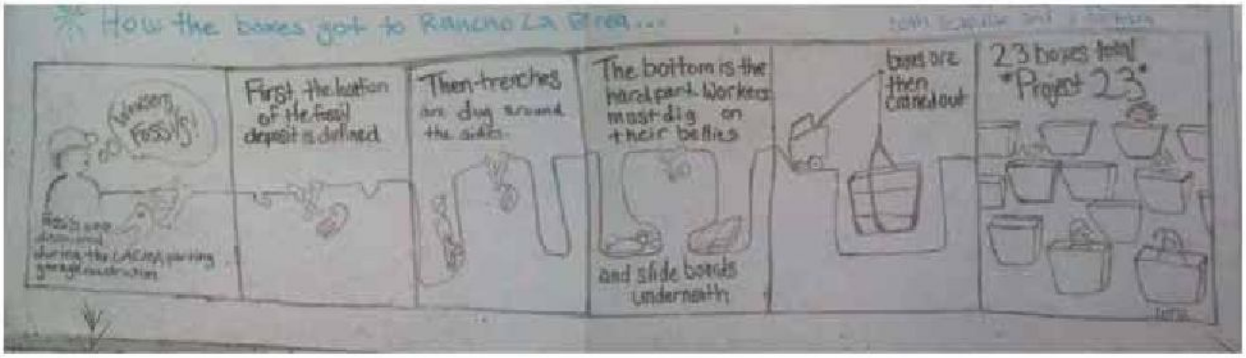
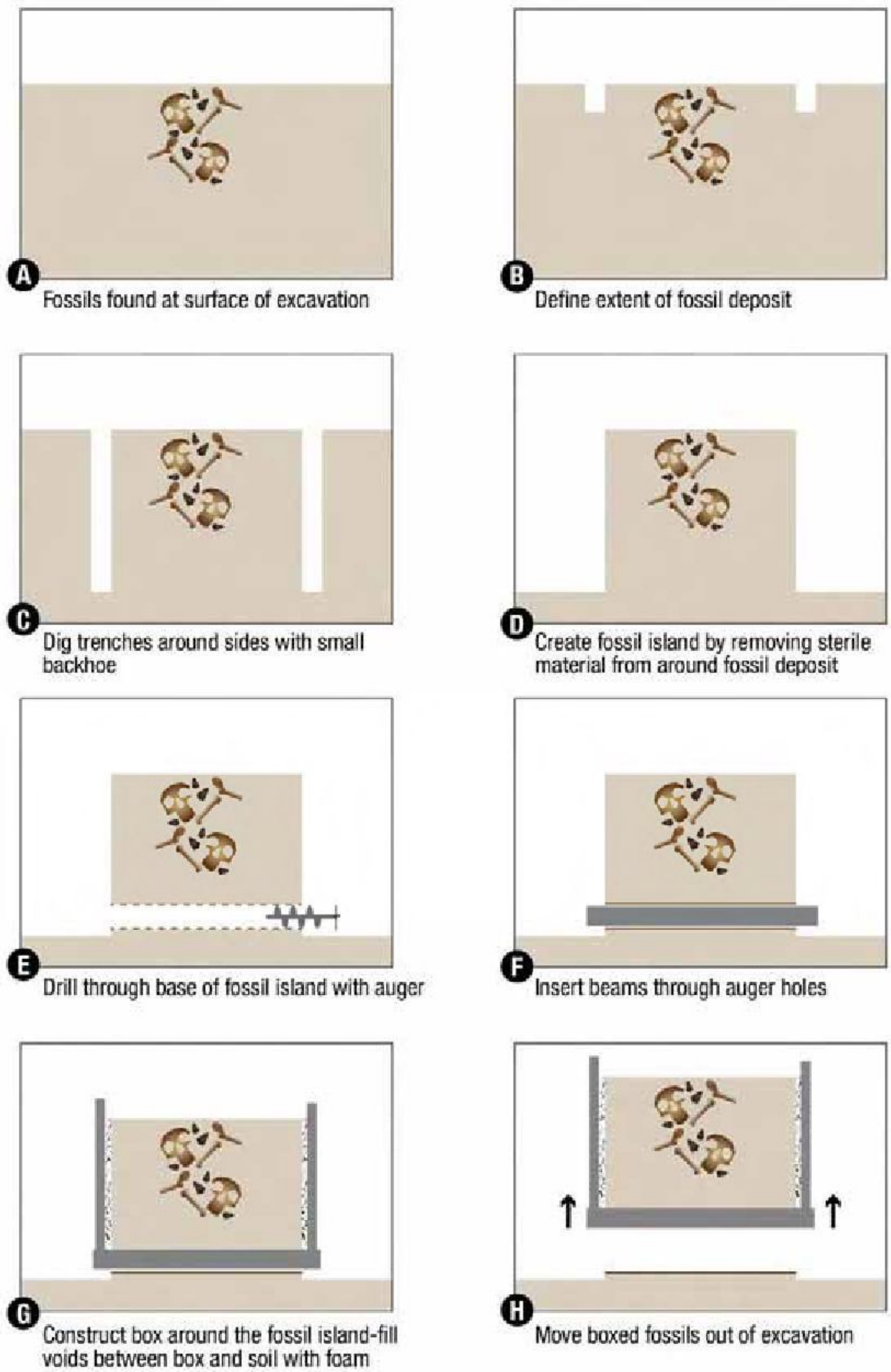


**Figure 4-16: Proposed Alternative Boxing Technique Using Auger for Floor Construction**



Depending on the size and weight of each box, fossils located beneath deck panels may be lifted in place by crane through temporary openings in the decking. However, this may prove to be impossible if street closure is not possible or the crane cannot be positioned on the street decking in a way to perform the lift. It is proposed to limit the size of fossil boxes to about 30 tons, i.e. 500 cubic feet which will make boxes easier to lift or to move around below the decking with low headroom equipment or with a system of skids and temporary tracks constructed within the station box. Once positioned adjacent to the side access shaft, fossil boxes can be lifted by mobile cranes positioned on "terra firma". The crane would lift the box out through the access shaft and load it on a truck which will transport the tar and fossils either to the Page Museum site where paleontologists can continue their work or to the contractor's laydown area at South Orange Grove/ Ogden for storage and processing. Offsite processing is preferred as there is less potential for damage by heavy equipment that will be operating at the South Orange Grove/Ogden laydown area.

## 4.5 Construction Issues in Tar-Laden Soils

The asphaltic sands have unique properties and the engineering characteristics are not as well documented as compared to other soils. However, contrary to common expectations, it is proven that these sands possess shear strength. Design parameters for excavation support systems in asphaltic sands will need to consider some additional pressure due to the makeup of these soils. There are numerous cases of successful experience in construction of deep basements and underground parking structures in the Wilshire/Fairfax area soils, such as construction of underground structures at LACMA (see Figure 4-17). Similar design elements, construction techniques and operating methods and procedures can be applied to the planned excavations.

**Figure 4-17: Aerial View of Project 23 Excavation with Dark Tar Seeps**

## 4.6 Potential Impacts to Construction Methods from Anticipated Tar-Laden Soils

When excavating in tar-laden soil, efforts will be undertaken to avoid excessive disturbance. Excavation methods will be closely controlled to minimize over-excavation or vibrations. When grade is achieved within these soils, a mud slab could be applied to minimize disturbance. In some cases, a layer of gravel may be placed over the asphaltic sands to increase traction and reduce the amount of soil compaction caused by construction traffic. The contractor can also apply various other materials on top of the tar such as cement, lime, or other additives to prevent it from fouling the tracked equipment. Wide tracked machinery can be used to reduce the pressure exerted on the soils below. Timber mats can make a sturdy foundation to drive equipment on. Rubber tire vehicles are considerably lighter than their tracked counterparts and could be operated with floatation tires specifically designed to minimize the amount of soil compaction caused by heavy equipment. Because the tar is rather sticky or tacky in some areas, it is anticipated that the equipment's tracks, axles, or buckets could become fouled and would require occasional cleaning. Steam cleaners would handle the task well, by heating the tar to a less viscous consistency.

## 4.7 Handling Gas Intrusions during Construction Operations

Previous projects in the Methane Risk Zone have been successfully and safely excavated. Multiple underground parking garages have been constructed in this area. For example, LACMA built a two-level subterranean parking structure in the Methane Risk Zone, previously referred to as Project 23. During the excavation, H2S (above safe working levels) was encountered on several occasions. Workers donned PPE to protect against exposure during these events (se Figure 4-18). Further investigation of operating underground structures will be undertaken during future design phases to assess effectiveness of barrier systems and detection equipment used.

**Figure 4-18: Fossil Boxes with Worker Donning Oxygen Respirator at Project 23**

Since the majority of gas is expected to enter the excavation through the excavation surface, the release of gases may be constricted by applying a ground cover to all areas except the area where current excavation operations are taking place. An impervious membrane of Visqueen plastic sheeting or geotextile fabric may serve this purpose.

In areas of potential H2S exposure, there are a number of techniques that can be used to lower the risk of H2S release or exposure. Because station excavations are less confined than tunnels, gas exposure issues are anticipated to be less significant. Although pre-treatment of the ground water prior to excavation, with additives such as hydrogen peroxide or copper-zinc, is an option, it is not expected to be required. If released, H2S will not naturally dissipate because it is heavier than air, hence it would build up around the bottom of the excavation. The first line of defense is dewatering since H2S occurs in a dissolved state in ground water. Dewatering will remove any contaminated water from the excavation area. At the surface, a sealed tank would capture the water and treat the air for H2S off-gassing before discharging it to the surrounding environment. Additionally, a ventilation system will be used to introduce fresh air in the workspace. Fans will be used to circulate the air while a gas detection system monitors levels of hazardous gas. A suction system fitted with scrubbers may be required to collect H2S from the bottom of the excavation and treat the air before discharging clean air at the street surface.

CH4 is a hazard in confined spaces. As such, it is essential that workers be sufficiently protected, and thus detection and monitoring equipment would be required. Fans similar to those used to dilute H2S concentrations would also dilute CH4 concentrations in the station box. Once above-ground, CH4 dissipates rapidly in the atmosphere and would not be a health hazard.

## 4.8 Ventilation Schemes

Ventilation is required to combat harmful or dangerous gasses when present in underground construction. Cal OSHA classifies subterranean work areas as “gassy”, “potentially gassy”, “non-gassy”, or “extra hazardous”. Excavation equipment in “gassy” spaces must be manufactured to resist accidental sparks and either be sealed or of explosion proof design.

Since CH4 and H2S gases are expected to be encountered during the excavation of Wilshire/Fairfax station, adequate ventilation and continuous air quality monitoring will be in use throughout construction. In addition to maintaining acceptable levels of CH4 and H2S in the air supply, the ventilation system must maintain a certain level airflow for workers present in the work space (see Figure 4-19) . The size of the system is dependent on the number of persons and the size of diesel equipment underground. The air supply shall not be less than 200 CFM (cubic feet per minute) per person underground, plus 100 CFM per diesel horse brake power.

Use of perforated deck panels, either perforated steel or concrete integrated with steel could be used in place of concrete only deck panels to allow the free flow of air between the excavation area and the surface, especially if full decking is required across the entire station box.

**Figure 4-19: Underground Ventilation Ducts**

# 5.0 CONCLUSIONS AND RECOMMENDATIONS

The project is committed to recover fossils and to work closely with the Page Museum to minimize the loss of fossils due to the construction of a station at Wilshire/Fairfax.

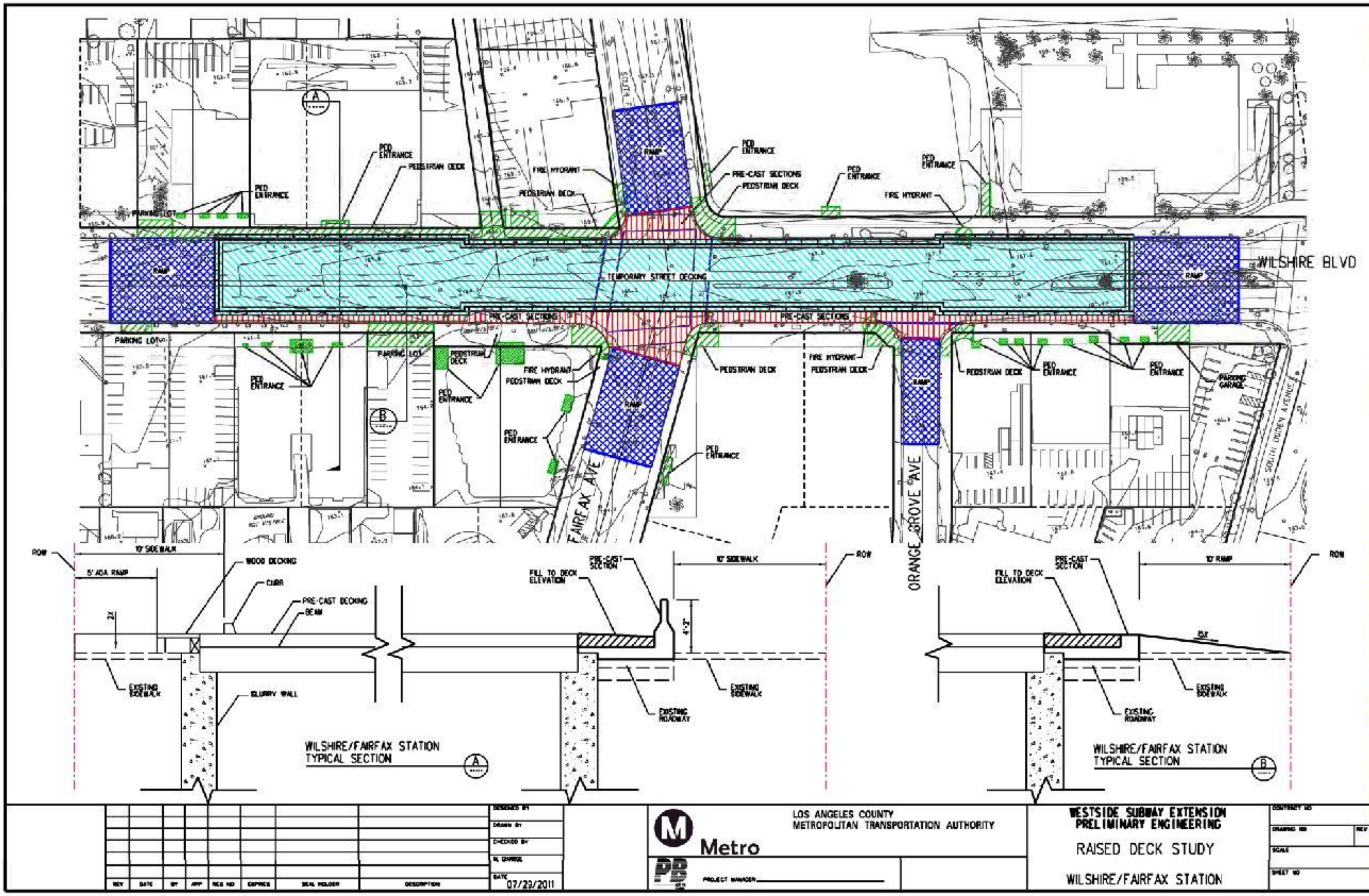
The project plans to use the same recovery methods that have been proven at Project 23, and with the cooperation of Page Museum staff, will seek to customize and improve on these methods to tailor them for the site conditions at Wilshire/Fairfax.

Further studies are on-going to find ways to raise the height of the beams used for street decking, which in turn, will leave more soil beneath the beams for controlled excavation and fossil recovery.

The fastest and lowest cost shoring method is preferred. This means that a soldier pile and lagging system will be employed provided that continuing geotechnical investigation do not find ground conditions that preclude this system. Soldier pile and lagging shoring has the added advantage of disturbing less of the station excavation footprint than other methods, minimizing the loss of fossils in this phase.

Gases will be controlled by installing adequate ventilation within the excavation, and by designing the street decking system with gaps for natural ventilation and elimination of pockets where gases could accumulate.

# APPENDIX A EXAMPLE OF RAISED DECKING




WESTSIDE SUBWAY EXTENSION PROJECT

# ATTACHMENT 4

cogstone

PALEONTOLOGY - ARCHAEOLOGY - HISTORY

# PALEONTOLOGICAL RESOURCES MONITORING AND MITIGATION PLAN FOR THE LOS ANGELES COUNTY METROPOLITAN TRANSPORTATION AUTHORITY

# PURPLE LINE EXTENSION PROJECT,

## LOS ANGELES, LOS ANGELES COUNTY, CALIFORNIA

**Submitted to:**

Westside Extension Support Team
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Woodland Hills, CA

Metropolitan Transportation Authority
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Los Angeles, CA

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May 2013; revised February 2015

***Project Number:*** 2068-003
***USGS 7.5' Quadrangles:*** Beverly Hills 1995, Hollywood 1966 (PR 1981), Los Angeles 1996 (PR 1981, MR 1994)
***Area:*** nine linear miles with seven stations
***Key Words:*** Fernando Formation, San Pedro Formation, Quaternary older alluvium, Rancho La Brea, Pleistocene fossils, Pliocene fossils, mitigation plan, La Brea Zone

# ABSTRACT

This Plan includes an overview of the Project, regional paleontological setting, significance criteria, and methods to be employed for monitoring, fossil recovery and evaluation, laboratory work, reporting and curation of paleontological resources encountered during the construction activities associated with the Purple Line Extension (PLE) Project proposed by the Los Angeles County Metropolitan Transportation Authority (Metro) and Federal Transit Administration (FTA).

Specific significance criteria and examples of application for fossils discovered are delineated. Generally fossils must be recovered to allow evaluation. When combined with observations on extent and integrity of the resource, this will allow rapid implementation of treatment measures and a concomitant minimization of work delays. All work within the La Brea Zone (2 mile radius around Page Museum at depths up to 55 feet below the surface) will have oversight from Page Museum staff.

The Purple Line (Westside Subway) Extension Project is located in western Los Angeles County and includes portions of the Cities of Los Angeles and Beverly Hills, as well as an unincorporated portion of Los Angeles County in the vicinity of the Greater Los Angeles Healthcare System-West Los Angeles Medical Center. The Project Alignment would extend heavy rail transit, in subway, from the existing Metro Purple Line Wilshire/Western Station to the Westwood/VA Hospital South Station, a distance of approximately nine miles. The separated right-of-way is all in a tunnel, with the top of the tunnel at least 30 to 70 feet below the ground surface. The extension would include a total of seven new stations.

More than a dozen fossil localities are known in non-asphaltic Quaternary older alluvium adjacent to the Project Alignment and have produced fossils including mammoth, mastodon, camel, horse, bison, deer, American lion and rodents. In the Project Alignment vicinity, the San Pedro Formation has produced horse, coyote, turtle, fish, shark, and numerous invertebrate fossils. While this formation is entirely marine, terrestrial animals such as fossil horse and coyote were washed into the ocean in streams or rivers. The Fernando Formation has produced invertebrate fossil in the Project Alignment but no vertebrate paleontological resources. Elsewhere in the Los Angeles Basin the formation has produced vertebrate fossils.

The late Pleistocene fossils of the La Brea tar pits are internationally known. Over 4 million specimens including mammals, birds, fish, plants and insects have been documented. The La Brea deposits are known within a two mile radius around the George C. Page Museum of La Brea Discoveries, an area known as the La Brea Zone.

Based on locations and depths of prior fossil discoveries, all excavations for stations and associated facilities and the drop/retrieval shafts for the tunneling machine require full time paleontological monitoring of native sediments. At Fairfax Station only, work from the bottom of imported fill to the top of the marine sediments will be performed using six inch lifts. Once marine sediments are encountered, regular excavation lifts will be utilized. Unanticipated discoveries along the Project Alignment may be encountered during trenching below existing streets or during other ground-disturbing activities. For unanticipated discoveries crews will stop work in the vicinity of the discovery so that the resource may be evaluated for significance. Evaluation and/or recovery operations will be completed as quickly as feasibly possible in order to minimize construction delays.

# TABLE OF CONTENTS

# 1. INTRODUCTION

## 1.1 PURPOSE OF DOCUMENT

This Plan includes an overview of the Project, regional paleontological setting, significance criteria, and methods to be employed for monitoring, fossil recovery and evaluation, laboratory work, reporting and curation of paleontological resources encountered during the construction activities associated with the Purple Line Extension (PLE) Project proposed by the Los Angeles County Metropolitan Transportation Authority (Metro) and Federal Transit Administration (FTA).

## 1.2 PROJECT DESCRIPTION AND LOCATION

The Purple Line (Westside Subway) Extension Project is located in western Los Angeles County and includes portions of the Cities of Los Angeles and Beverly Hills, as well as an unincorporated portion of Los Angeles County in the vicinity of the Greater Los Angeles Healthcare System-West Los Angeles Medical Center (Figure 1). The Project Alignment would extend heavy rail transit, in subway, from the existing Metro Purple Line Wilshire/Western Station to the Westwood/VA Hospital South Station, a distance of approximately nine miles. The separated right-of-way is all in a tunnel, with the top of the tunnel at least 30 to 70 feet below the ground surface. The extension would include a total of seven new stations.

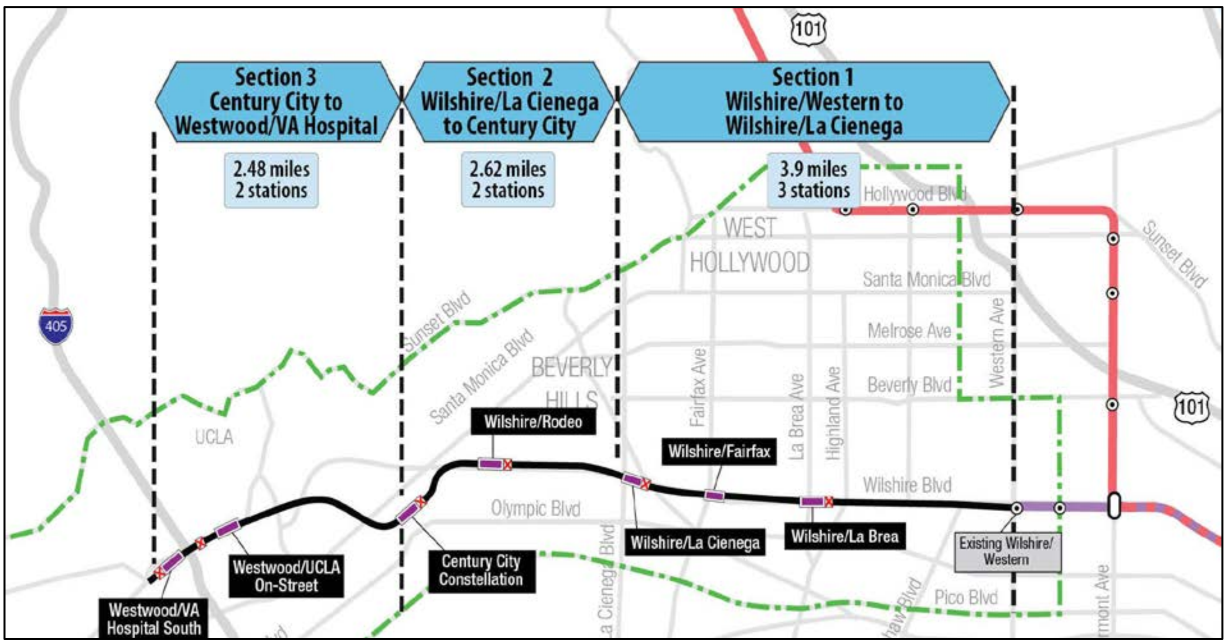


**Figure 1. Project Sections and Components**

## 1.3 PLE MITIGATION REQUIREMENTS

The Federal Transit Administration (FTA) is acting as the Federal lead agency for this Project. Metro is the cooperating State lead agency. A Final Environmental Impact Statement/Environmental Impact Report (EIS/EIR) for the undertaking was approved in March 2012 (Metro 2012). The instructions contained in this document, (together with the already completed Paleontology Exploratory Shaft), if implemented, will ensure compliance with Metro's legally binding obligation to enact the Paleontology Mitigation Measures contained in the Final Environmental Impact Statement/Environmental Report.

Metro retained the services of a qualified Principal Paleontologist in 2012 (Appendix A). This document is the Paleontological Resources Monitoring and Mitigation Plan (PRMMP) required. Metro is currently implementing the PRMMP during preconstruction utility relocations and will do so for construction once that phase of work begins. This PRMMP includes specifications for processing, stabilizing, identifying, and cataloging any fossils recovered on the PLE. It also includes provisions for curation of scientifically significant fossils.

Upon conclusion of construction excavations on the Project, the Principal Paleontologist will prepare a report detailing the paleontological resources recovered, their significance, and interpretation. Yearly progress reports will be prepared since the Project has a long time frame. Repositories for the Project will be the George C. Page Museum for fossils from the La Brea Zone, the Natural History Museum of Los Angeles County for fossils outside the La Brea Zone and the University of California Museum of Paleontology for plant fossils.

# 2. PALEONTOLOGICAL SETTING

The paleontological context prepared for the present study is based on information from the *Cultural Resources Technical Report* (URS 2010), the Final EIS/EIR (Metro 2012:Section 4.14) in addition to data from Fraser and Sues (2013), Gust (2012), Harris and Jefferson (1985), Parsons Brinckerhoff (2012), Powell and Stevens (2000), Quinn et al (2001) and tarpits.org.

## 2.1 GEOLOGY

### 2.1.1 Artificial Fill

Discontinous deposits of artificial fill are present in some locations up to 13 feet deep. These sediments were generally imported from other locations for past construction purposes. It generally consists of silty sand, silt, clay and gravel of varying colors.

### 2.1.2 Quaternary younger alluvium and fan deposits

These sediments are Holocene in age (less than 11,000 years old) and were deposited by streams flowing over the Project area. The sediments are typically yellow sand, silt and clay up to five feet deep.

### 2.1.3 Quaternary older alluvium and fan deposits

These sediments are late Pleistocene in age (50 to 11 thousand years old) and were also deposited by streams flowing over the Project area. The sediments are layered yellow silt sand, clay, silty clay and silt with some gravel. Quaternary older alluvium was encountered from about two to about 40 feet deep.

### 2.1.4 San Pedro Formation

The marine San Pedro Formation (one million to 50 thousand years old) is generally below the alluvium. The sediments consist of mostly greenish gray and bluish gray fine-grained sand, medium to course-grained sand, and some layers of silt. The San Pedro Formation was found as shallow as 12 feet below the surface and as deep as 100 feet.

### 2.1.5 Fernando Formation

The marine Fernando Formation (five to one million years old) underlies the San Pedro Formation and mostly consists of massive buff siltstone with some claystone layers. The Fernando Formation was identified as shallow as 65 feet below the surface.

## 2.2 PALEONTOLOGY

Work under this plan is divided between most Project sediments, regardless of geological formation and depth, and those within the La Brea Zone which are entirely Quaternary older alluvium saturated with asphalt and extend no more than 55 feet below the surface. Most such deposits discovered in the past have been less than 35 feet deep; however, the staff of the Page Museum specifically requested that a maximum depth of 55 feet be included in this document to account for the fact that natural ground surface slopes toward the ocean (John Harris, Chief Curation of Earth Sciences, personal communication, 2013). The La Brea Zone has a radius of two miles around the George C. Page Museum of La Brea Discoveries.

### 2.2.1 Deposits outside the La Brea Zone

More than a dozen fossil localities are known in non-asphaltic Quaternary older alluvium adjacent to the Project Alignment and have produced fossils including mammoth, mastodon, camel, horse, bison, deer, American lion and rodents. In the PLE vicinity, underlying sediments may be non-asphalt or asphaltic. The San Pedro Formation has produced horse, coyote, turtle, fish, shark, and numerous invertebrate fossils. While this formation is entirely marine, terrestrial animals such as fossil horse and coyote were washed into the ocean in streams or rivers. The Fernando Formation has produced invertebrate fossils in the Project Alignment but no vertebrate paleontological resources. Elsewhere in the Los Angeles Basin the formation has produced vertebrate fossils.

### 2.2.2 Deposits within the La Brea Zone

The late Pleistocene fossils of the La Brea tar pits are internationally known (Fraser and Sues 2013, Harris and Jefferson 1985). Over four million specimens including mammals, birds, fish, plants and insects have been documented.

Prehistorically, local Native Americans collected and utilized the asphaltum at La Brea for both waterproofing and glue. The alignment of Wilshire Boulevard was the original indian trail to the tar pits. After El Pueblo de la Nuestra Señora la Reina de los Angeles was founded in 1781, the residents of the town used the asphaltum to waterproof their roofs and as fuel. Fossils were probably discovered and collected in both prehistoric and early historic times. By the late nineteenth century, La Brea was owned by the Hancock family. They gave a saber cat canine tooth to a visiting professor named William Denton who published the first description of the fossils from La Brea.

Between 1907 and 1913 there was a flurry of fossil collecting at La Brea by The University of California at Berkeley, the Southern California Academy of Sciences, and Los Angeles High School. The scientific importance of these collections was instrumental in the Hancock family’s decision to donate the land to the County as a scientific park. The fledgling Los Angeles County Museum conducted excavations from 1913 to 1915 and again in 1929 of more than 100 separate localities. The focus was on collecting large animals and they successfully collected about one million fossils.

In 1969, the Museum reopened excavations at La Brea at Pit 91. This pit was discovered and partially excavated in the early 20$^{th}$ century but deliberately backfilled and preserved for future excavation. Pit 91 was excavated with vastly improved technical methods and focused on recovering small and microscopic specimens in addition to taphonomic information such as how the fossils were oriented. These new excavations doubled the number of species known; particularly of small mammals, fish, lizards, frogs, snails, plants, and insects.

In 1975, when the foundations for the Page Museum were being excavated, fossils were discovered there also. The fossils were divided into blocks and jacketed (covered with burlap soaked in plaster to make a strong, protective casing) for later excavation in the laboratory. These jackets yielded the first articulated skeletons of individual animals known from La Brea. One of the articulated animals was a saber cat and it was discovered that past assumptions regarding the order and placement of bones of the forepaw of sabercats had been incorrect.

In 2006, new La Brea Zone deposits were discovered at Wilshire and Ogden during excavations for a parking garage. These included 23 new localities in asphaltic matrix as well as some non-asphaltic deposits with fossils. Among the new discoveries from the portions of this material excavated to date is recovery of the most complete individual skeleton of a mammoth known at La Brea.

### 2.3 PALEONTOLOGICALLY SENSITIVE AREAS

Based on locations and depths of prior fossil discoveries, all excavations in native sediments (non-fill) for stations and associated facilities and the drop/retrieval shafts for the tunneling machine require full time paleontological monitoring. Construction of the Project Alignment is expected to encounter La Brea Zone fossils at the Wilshire/Fairfax Station and possibly at Wilshire/La Brea Station. All stations have potential to encounter non-asphaltic or asphaltic fossils from the marine formations. No monitoring is required for any other Project components. The tunneling for the subway is exempt from monitoring due to logistics of the machinery which drills and then immediately exudes the tunnel wall materials. Unanticipated discoveries along the Project Alignment may be encountered during trenching below existing streets or during other ground-disturbing activities.

## 3. SIGNIFICANCE CRITERIA

### 3.1 DEFINITION OF SIGNIFICANCE FOR PALEONTOLOGICAL RESOURCES

Only qualified, trained paleontologists with specific expertise in the type of fossils being evaluated can determine the scientific significance of paleontological resources. Fossils are considered to be significant if one or more of the following criteria apply:

1. The fossils provide information on the evolutionary relationships and developmental trends among organisms, living or extinct;
2. The fossils provide data useful in determining the age(s) of the rock unit or sedimentary stratum, including data important in determining the depositional history of the region and the timing of geologic events therein;
3. The fossils provide data regarding the development of biological communities or interaction between paleobotanical and paleozoological biotas;
4. The fossils demonstrate unusual or spectacular circumstances in the history of life;
5. The fossils are in short supply and/or in danger of being depleted or destroyed by the elements, vandalism, or commercial exploitation, and are not found in other geographic locations.

As so defined, significant paleontological resources are determined to be fossils or assemblages of fossils that are unique, unusual, rare, uncommon, or diagnostically important. Significant fossils can include remains of large to very small aquatic and terrestrial vertebrates or remains of plants and animals previously not represented in certain portions of the stratigraphy. Assemblages of fossils that might aid stratigraphic correlation, particularly those offering data for the interpretation of tectonic events, geomorphologic evolution, and paleoclimatology are also critically important (Scott and Springer 2003).

## 4. RESOURCE ASSESSMENT METHODS

This section details the statutory requirements and standard professional methods used to evaluate paleontological resource significance. The methods discussed include those used to conduct fieldwork, recover fossils, document localities, prepare specimens, identify specimens, analyze specimens and formally evaluate significance of fossils identified during the course of the Project.

The potential to impact fossils varies with depth of impacts, previous disturbance and presence of non-fossiliferous sediments. Unidentifiable fossils will generally not meet significance criteria and should not be collected unless the quantity and preservation is sufficient for dating purposes (criterion 2 above). For identifiable fossils, significance will need to be assessed subsequent to recovery but generally single fossils are isolated finds that will not meet significance criteria unless they represent previously unknown species in the area or they provide a useful radiocarbon date that assists with local sedimentary sequencing (criteria 2 and 5 above). This is because single fossils, such as a left bison tibia, do not have sufficient data potential to evaluate evolutionary relationships, development of biological communities, interaction between paleobotanical and paleozoological biotas, or unusual or spectacular circumstances in the history of life (criteria 1, 3 and 4 above). Associations of whole or partial skeletons of different animals are likely to meet multiple significance criteria. Deposits which are determined to be part of the Rancho La Brea deposits will meet criterion 4 at a minimum.

# 5. WORKER PALEONTOLOGICAL AWARENESS TRAINING

All Project management supervisory and earth-moving personnel, including construction workers, inspectors and supervisors, will receive Paleontological Resources Awareness Training prior to commencement of any ground-disturbing activity. The training program was developed by the author of this document to ensure consistency. The training will include instruction on: (1) the possibility of unearthing fossils; (2) the types of fossils and deposits that may be unearthed and how to recognize them; (3) the importance of, and legal basis for, the protection of significant resources; and (4) the requirement that they immediately halt work within 50 feet of discovery of fossils.

All attendees will sign to verify that they understand the Project mitigation requirements and will be issued hard-hat stickers. Personnel will be required to affix the stickers prior to signing. New personnel commencing work on the project must receive the training prior to start of work.

Paleontological Resources Awareness Training will be provided in at least two setting – classroom and field tailboard. The training presentation will take about 15 minutes and 10 minutes will be allowed for questions. A current contact list will be provided to each attendee. The worker education will include visuals of fossils that might be found in the project vicinity. Presentations for management personnel may be conducted as presentations utilizing computer software. Presentations for field construction crews (generally less than 10 people) may be conducted in the field as tailboard flipbook presentations.

# 6. TREATMENT OF FOSSILS OUTSIDE THE LA BREA ZONE

## 6.1 SCOPE OF WORK

This section of the work plan was developed to guide and facilitate the identification and treatment of paleontological resources located in non-asphaltic Quaternary older alluvium and non-asphaltic or asphaltic underlying sediments during the Project in an effort to reduce adverse effects on significant resources. Since the La Brea Zone is a maximum of 55 feet deep, this applies to sediments that underlie the Quaternary sediments even at Wilshire/Fairfax Station.

## 6.2 PALEONTOLOGICAL PERSONNEL

The qualified Principal Paleontologist retained by Metro, Sherri Gust, has a graduate degree, more than ten years of experience as a Principal Paleontologist, demonstrated expertise in vertebrate paleontology, and has been specifically approved by the Museum. The Principal Paleontologist will be responsible for ensuring that all subordinate personnel are appropriately qualified.

Personal protective equipment (PPE) may be required for safe working conditions. All will receive a comprehensive safety manual and Project-specific safety training. Attendance at job site safety meetings is required of all paleontological field personnel. Paleontological field personnel will wear clothing appropriate to the jobsite and are required to wear hard hats, safety vests, hard-toed boots and hearing protection in active construction zones.

## 6.3 MONITORING

### 6.3.1 Full-time Monitoring

All excavations for stations and associated facilities and the drop/retrieval shafts for the tunneling machine require full time paleontological monitoring below any fill. All stations and the drop/retrieval shaft locations may encounter paleontological resources in non-asphaltic sediments outside the La Brea Zone (both horizontally and vertically). No excavation is permitted at any of these locations without presence of a paleontological monitor.

### 6.3.2 On-Call Monitoring

No monitoring is required for any other Project components other than those stated above. The tunneling for the subway is exempt from monitoring due to logistics of the machinery which drills and then immediately exudes the tunnel wall materials. Unanticipated discoveries may be encountered during trenching below existing streets or during other ground-disturbing activities. The crew should immediately halt work in that specific location and notify the Principal Paleontologist. Work may resume immediately a minimum of 50 feet from the find.

### 6.3.3 Construction Phase Schedule

Metro will provide the Principal Paleontologist with an initial schedule of subsurface ground-disturbing activities to be conducted within the Project limits in writing at least 15 working days prior to beginning of construction and update the schedules as needed. The Contractor will make arrangements for the Paleontological Monitoring Team to be at the work site in accordance with these requirements.

### 6.3.4 Monitor's Authority to Temporarily Halt Project Activities

Paleontological monitors may temporarily divert equipment to inspect fossil finds and reveal the extent of deposits. The excavation contractor will cooperate with the monitor and assist with sediment removal around fossil deposits at the request of the monitor and with approval of Metro. Metro will be responsible for final decisions regarding the issuance and duration of any formal Suspend Work orders.

### 6.3.5 Monitoring Methods and Documentation

The paleontological monitor will maintain close communication with the on-site resident engineer and earthmoving personnel in order to maintain a safe working environment and to be fully appraised of the upcoming areas of impact and any schedule changes.

The paleontological monitor is responsible to complete daily documentation of monitoring presence and daily documentation of monitoring activities including the location of monitoring activities throughout the day and the type, observations of sediment type and distribution, observations regarding fossils, collection of fossils and other information. The paleontological monitor is responsible to photograph activities, sediments and paleontological resources for documentation purposes and to fill out a Photograph Record Sheet daily. All paperwork and photographs will be submitted to the Principal Paleontologist weekly. All documentation will be filed and maintained by the Principal Paleontologist.

### 6.3.6 Reporting

A weekly email summary will be submitted to Metro. If fossils are observed, the Contractor and Metro will be immediately notified. Additional documentation will also be incorporated if fossils are recovered. These records and the field notes will be used to prepare a monthly letter report. The monthly reports will summarize the monitoring activities of the previous period, discoveries made, and other information as appropriate. Monthly reports will be submitted to the Metro.

Upon conclusion of the Project, a final report will be prepared. The final report will include the inclusive dates of monitoring, personnel utilized including qualifications, summarize the monitoring effort and coverage using text and maps, documentation of paleontological localities discovered, paleontological resources identified, interpretation of fossils, evaluation of the adequacy of this paleontological resources management plan and suggestions for improving paleontological resource monitoring procedures and include all specialists' reports as appendices. The report will be submitted to Metro and the repository.

## 6.4 Fossil Discovery and Recovery

Fossils observed will be treated differently depending on type and circumstance. Generally, discovery of identifiable invertebrate (shells, crustaceans, etc.) fossils requires a scientifically significant sample be collected for identification and analysis and that the locality be documented (see below). Similar procedures are followed for microvertebrates such as rodents. Current professional standards call for testing of 200 lb. samples (four-five full five gallon buckets) from each locality followed by processing of up to 6000 lbs. of matrix if significant fossils are recovered by testing. Documentation of localities is required.

Larger fossils observed must be evaluated to determine their condition. Generally the monitor will be able to quickly determine if the fossils are sufficiently well-preserved to meet preliminary significance criteria. If necessary, the monitor will cordon off the immediate area around the fossil to permit a safe work zone to recover the fossil and notify the construction foreman. The monitor will also immediately notify the field supervisor if assistance is needed and sufficient personnel to perform the work will be fielded. Documentation of localities is required.

Discovery of a bone bed or other type of fossil sites containing multiple large fossils may require a formal Stop Work order. The monitor will cordon off the area until evaluation occurs. The Principal Paleontologist will consult with the Metro Cultural Resources Coordinator regarding the amount of time necessary. This type of discovery requires a detailed field map, a sedimentary structure analysis, one or more stratigraphic columns and data for taphonomic analysis.

Depending on the formations being impacted additional samples collected may include specimens for dating analyses or materials for microfossil, botanical or pollen analyses. All fossils and sediment samples are accompanied by a field tag with Project and locality information including a unique field number.

### 6.4.1 Fossil Locality Documentation

Every fossil locality requires a standard set of data be taken. This includes one or more coordinate readings using a resource grade high resolution GPS device such as a Trimble GeoXH or better. Currrently, the combination of Trimble GeoXH and most recent updates to the post-processing software permit an average accuracy of four". All field members of the Paleontological Team will be trained in the use of the resource grade GPS prior to start of the Project. The Paleontological Team will coordinate with the prime construction contractor to obtain accurate elevation readings. Lithology, paleoenvironmental information and a true north reading are also required. Additional information collected may include one or more stratigraphic columns, sedimentary structure analysis, taphonomic analysis and photographs of the fossil *in situ*. Depending on the formations being impacted additional samples collected may include specimens for dating analyses or materials for microfossil, botanical or pollen analyses.

If recovered fossils are within the limits of radiocarbon dating, samples will be submitted to Beta-Analytic to obtain dates. If fossils are demonstrably older, radiocarbon may not be feasible and alternative dating methods will be utilized if possible such as optical luminescence dating.

#### 6.4.2 Fossil Preparation

Many fossils require only cleaning and stabilization through the use of hardeners. Others require lab excavation of plaster jackets with gradual cleaning and hardening. Sometimes larger fossils require a "cradle", usually a form-fitted plaster lined with acid-free cloth to provide support and prevent breakage during storage or transport. Fossils found in bedrock formations may require more tedious preparation using mechanical devices such as zip scribes.

Processing of matrix samples for microvertebrates varies depending on the nature of the sediments and may be washed using water, may require chemical agents to break apart the rock or may require floatation using heavy liquids. Sediment to be screenwashed will be transported to the lab for mechanical screen washing.

#### 6.4.3 Fossil Identification

All fossils will be identified by experts. All identifications will be as specific as possible and include element, portion, side, sex, age, taphonomy and notes. Cataloging, including identification information, is entered into a computer database. Each specimen is maintained with a tag specifying the provenience and identification information.

#### 6.4.4 Fossil Analyses

Analyses conducted depend to a great extent on the number of fossils recovered and their condition. Guild analysis (relative number of carnivores, herbivores and omnivores of various body weights in an ecosystem), demographic analysis (age and sex structure of populations), habitat analysis (certain types of animals indicate grasslands as opposed to deserts for example), paleoecology (use of botanical and/or pollen analysis to reconstruct the paleoenvironment) and comparative analysis (comparison to other faunas of the same time period regionally) are the most typical. Geological context analyses include stratigraphy of the fossil deposit, dating (to narrow the time range of the fossils), taphonomy (history of alteration of the fossils by scavengers, water transport, etc.) and other ancillary studies.

#### 6.4.5 Fossil Curation and Discard Protocol

Fossils meeting significance criteria will be curated in perpetuity at an accredited repository along with all Project data and a copy of the final report. Fossils are only to be removed from a collection at the discretion of the Principal Paleontologist. Typically specimens are discarded to educational uses because the fossil was not identifiable to at least family level, was not found *in situ* or was part of a large collection of the same species from the same locality and individual specimens in poor condition are discarded.

#### 6.4.6 Fossil Repository

The Natural History Museum of Los Angeles County will be the repository for all significant fossils from outside the La Brea Zone. Plant fossils will be curated at the University of California Museum of Paleontology. FTA/Metro will make available Project funds to pay for curating the collection.

# 7. TREATMENT OF FOSSILS WITHIN THE LA BREA ZONE

## 7.1 Scope of Work

This section of the work plan was developed to meet the requirements of the 2011 Memorandum of Understanding (MOU) between the Metropolitan Transportation Authority of Los Angeles County (Metro) and the Natural History Museum of Los Angeles County (Museum) (see Attachment B) and subsequent communication (see Attachment C). Implementation of the paleontological resources mitigation plan will guide and facilitate the identification and treatment of paleontological resources located during the Project in an effort to reduce adverse effects on significant resources.

Geotechnical work for the Project did not reveal asphaltic deposits at Wilshire/La Brea and on that basis this section applies to Wilshire/Fairfax station from the bottom of fill to the top of the marine sediments only. These are typically Quaternary older alluvium saturated with asphalt and contain terrestrial and freshwater species only. The George C. Page Museum of La Brea Discoveries will provide oversight to ensure that data standards are met and will be the repository for any fossils recovered.

## 7.2 Paleontological Personnel

The qualified Principal Paleontologist retained by Metro, Sherri Gust, has a graduate degree, more than ten years of experience as a Principal Paleontologist, demonstrated expertise in vertebrate paleontology, demonstrated expertise in the paleontology of Rancho La Brea and has been specifically approved by the Museum. The Principal Paleontologist will be responsible for ensuring that all subordinate personnel are appropriately qualified.

In addition to preparing this mitigation plan the Principal Paleontologist will coordinate with the Museum for all activities, supervise monitoring of all subsurface ground disturbance, recovery of the fossil deposits, ensure data collection in accord with MOU, provide progress reports and ensure that construction delays are minimized while preserving significant fossils. When requested by the Museum, the Principal Paleontologist will ensure appropriate identification and maintain necessary space for storage and laboratory work on recovered deposits at a secure laboratory facility.

Due to environmental hazards including subsurface methane and hydrogen sulfide, all paleontological field personnel including selected Museum staff must participate in all special training offered by Metro for safety. Personal protective equipment (PPE) may be required for safe working conditions. All will receive a comprehensive safety manual and Project-specific safety training. Attendance at job site safety meetings is required of all paleontological field personnel. Paleontological field personnel will wear clothing appropriate to the jobsite and are required to wear hard hats, safety vests, hard-toed boots and hearing protection in active construction zones.

## 7.3 Monitoring

### 7.3.1 Full-time Monitoring

All excavations for stations and associated facilities and the drop/retrieval shafts for the tunneling machine require full time paleontological monitoring below any fill. All stations and the drop/retrieval shaft locations may encounter paleontological resources. No excavation in native sediments (this excludes fill) is permitted without presence of a paleontological monitor.

### 7.3.2 On-Call Monitoring

No monitoring is required for any other Project components other than those stated above. However, unanticipated discoveries along the Project Alignment may be encountered during trenching below existing streets or during other ground-disturbing activities. The crew should immediately halt work in that specific location and notify the Principal Paleontologist. Work may resume immediately a minimum of 50 feet from the find.

### 7.3.3 Construction Phase Schedule

Metro will provide the Principal Paleontologist and Museum with an initial schedule of subsurface ground-disturbing activities to be conducted within the Project limits in writing at least 15 working days prior to beginning of construction and update the schedules as needed. The Contractor will make arrangements for the Paleontological Monitoring Team to be at the work site in accordance with these requirements.

### 7.3.4 Monitor's Authority to Temporarily Halt Project Activities

Paleontological monitors may temporarily divert equipment to inspect fossil finds and reveal the extent of deposits. The excavation contractor will cooperate with the monitor and assist with sediment removal around fossil deposits at the request of the monitor and with approval of Metro. Metro will be responsible for final decisions regarding the issuance and duration of any formal Suspend Work orders.

### 7.3.5 Monitoring Methods and Documentation

The paleontological monitor will maintain close communication with the on-site resident engineer and earthmoving personnel in order to maintain a safe working environment and to be fully appraised of the upcoming areas of impact and any schedule changes.

Fill does not require monitoring but all excavations in native sediments require full time paleontological monitoring. Due to the special circumstances of asphaltic deposits (Attachment B), all grading for Fairfax Station from the bottom of the fill to the top of the marine sediments will proceed in shallow removals of six inch lifts. This requirement does not apply to Western, La Brea or La Cienega drop shaft/station excavations as no asphaltic matrix was observed in any geotechnical boring at these locations. The paleontological monitor will need to be in direct proximity to the excavations to be able to observe fossils uncovered by grading. As noted above, the monitor has the authority to temporarily halt excavations if fossils are observed.

The paleontological monitor is responsible to complete daily documentation of monitoring presence and daily documentation of monitoring activities including the location of monitoring activities throughout the day and the type, observations of sediment type and distribution, observations regarding fossils, collection of fossils and other information. The paleontological monitor is responsible to photograph activities, sediments and paleontological resources for documentation purposes and to fill out a Photograph Record Sheet daily. All paperwork and photographs will be submitted to the Principal Paleontologist weekly. All documentation will be filed and maintained by the Principal Paleontologist.

### 7.3.6 Reporting

A weekly email summary will be submitted to Metro and forwarded to the Museum by Metro. If fossils are observed, the Museum, Contractor and Metro will be immediately notified. Additional documentation will also be incorporated if fossils are recovered. These records and the field notes will be used to prepare a monthly letter report. The monthly reports will summarize the monitoring activities of the previous period, discoveries made, Museum involvement and other information as appropriate. Monthly reports will be submitted to the Metro.

Upon conclusion of the Project, a final report will be prepared. The final report will include the inclusive dates of monitoring, personnel utilized including qualifications, summarize the monitoring effort and coverage using text and maps, documentation of paleontological localities discovered, paleontological resources identified, interpretation of fossils, evaluation of the adequacy of this paleontological resources management plan and suggestions for improving paleontological resource monitoring procedures and include all specialists' reports as appendices. The report will be submitted to Metro and the Museum.

## 7.4 La Brea Zone Fossil Discovery and Recovery

If La Brea Zone fossils are discovered, Metro and the Museum will be immediately notified. The Principal Paleontologist in consultation with the Museum will determine the best method of collecting any fossil or deposit. All work will be expedited to minimize construction delays. The extent of the fossil deposit will require controlled excavation by the paleontological monitor and assistance from additional paleontological personnel will be provided as needed. The contractor may be requested to assist the paleontological team with sediment removal. All fossil localities will be extensively recorded using a Trimble GeoXH high resolution GPS unit to ensure precise locational data. If satellite reception by the GPS unit is not adequate, localities will be mapped using triangulation of multiple metric tape measures.

Asphaltic fossil deposits may be conical or tabular and range from five to 20 ft. across. If a conical deposit is found and the extent has been determined the sediment surrounding it will be carefully removed by the paleontological team with possible assistance from the contractor so that the deposit is fully exposed except for a pedestal of dirt under the deposit. The deposit is reinforced with wooden planks surrounded by metal bands and covered with nylon or plastic tarping to preserve the integrity of the deposit. A custom tree box can then be constructed around each deposit. The space between the tarping and box must be filled in with foam or preferably fill/gravel of a distinctly different color than the native sediments to prevent deformation of the deposit during transit while making the packing material easily differentiable. More metal bands are added around the outside of the completed tree box. Subsequently, the sediment beneath the tree box is removed by tunneling so that the box floor can be constructed. The field number of the locality and the locality data will be placed on the exterior of the box, in addition to the field notes, using permanent ink or paint. A crane is used to place the tree box on a flatbed truck for transit. Boxes will be moved to the Page Museum or a secure laboratory of the Principal Paleontologist depending on space required. [Attachment B]

Non-asphaltic fossil deposits can consist of single bones or whole skeletons. These fossils must be stabilized using conventional paleontological methods such as hardeners and plaster jackets in order to be removed. These fossils can generally be moved onto truck by hand. [Attachment B]

### 7.4.1 La Brea Zone Locality Documentation

Every fossil locality requires a standard set of data be recorded. A field number is assigned to each locality and sometimes to multiple specimens. Field number convention to be utilized consists of the numerical year, the numerical month, the date, followed by the monitor's initials, and possibly a specimen number (for example, 20120427 SMG.1). Multiple precise location readings with resource grade GPS (Trimble GeoXH), creation of an accurate field map, accurate elevation measurements, depth below surface, lithology including Munsell Soil Color Chart evaluation, and true north reading are necessary. Additional information collected may include one or more stratigraphic columns, sedimentary structure analysis, taphonomic analysis and photographs of the fossil *in situ*. Tree boxed deposits and plaster jackets must have the permanent markings indicating top and bottom of deposit, north arrow and field number as well as reference corners (coordinated with GPS readings).

### 7.4.2 La Brea Zone Treatment Decisions

The MOU provides that recovered fossils will be evaluated by the Museum for a determination about who will prepare and identify the fossils. The Museum will be involved in oversight of any fossils prepared by the Principal Paleontologist's team.

Metro and the Museum will determine when fossils are prepared. This may be immediately after recovery or may await full Project construction. Generally, immediate preparation is preferred to prevent drying out of the sediments and subsequent problems with the integrity and scientific value of the deposits due to slumping and other deformations. Decisions about further analysis will depend on the nature of the deposit recovered and the potential of the fossils to provide information new to science.

### 7.4.3 La Brea Zone Asphaltic Fossil Preparation

A detailed protocol has been prepared and is included by reference (Attachment B). Under the direction of the Museum the fossils will be prepared either by the Museum or by the Principal Paleontologist overseen by Museum personnel in accordance with the protocol and the MOU.

# 8. REFERENCES CITED

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Quinn, James P., Daniel J. Ponti, John W. Hillhouse, Charles L. Powell, Kristin McDougall, Andrei M. Sarna-Wohcicki, John A. Barron, and Robert J. Fleck
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2003 CEQA and fossil preservation in southern California. *The Environmental Monitor* Winter: 4-10, 17.

# ATTACHMENT A: QUALIFICATIONS

cogstone
PALEONTOLOGY - ARCHAEOLOGY - HISTORY

**SHERRI GUST**
Project Manager & Principal Paleontologist

## EDUCATION

1994 M. S., Anatomy (Evolutionary Morphology), University of Southern California, Los Angeles
1979 B. S., Anthropology (Physical), University of California, Davis

## SUMMARY QUALIFICATIONS

Gust has more than 34 years of experience in California, acknowledged credentials for meeting national standards, and is a certified/qualified principal paleontologist in all California cities and counties that maintain lists. She holds California and Nevada statewide BLM paleontology permits. Gust is an Associate of the Natural History Museum of Los Angeles County in the Vertebrate Paleontology and Rancho La Brea Sections. She is a Member of the Society of Vertebrate Paleontology and the Society of Economic Paleontologists and Mineralogists. She has special expertise in the identification and analysis of fossil bone.

## SELECTED PROJECTS

**Aroleda Drive Freeway Project.** Paleontological Monitoring for 5 mile segment of State Route 99 south of Merced. Some 128 localities and 1667 fossils recovered in five months of excavation for detention basins. Project Manager and Principal Paleontologist. 2012. Subconsultant to URS.

**Plainsburg Interchange Project.** Paleontological Mitigation Plan with updated assessment for 5.5 mile new road segment and interchange on State Route 99 between Chowchilla and Merced. Project Manager and Principal Paleontologist. 2012. Subconsultant to URS.

**Westside Subway Exploratory Shaft Project.** Paleontological Mitigation Plan for deep exploration prior to excavation of new subway station near the La Brea tar pits. Project Manager and Principal Paleontologist. 2012. Subconsultant to PB.

**Santa Clara County Express Lanes Project.** Paleontological Evaluation Report and Mitigation Plan for 34 miles of State Route 85 in San Jose and Mountain View. Project Manager and Principal Paleontologist. 2012. Subconsultant to URS.

**Topock Groundwater Remediation Project.** Paleontological Resources Management Plan with updated evaluation for 794 acre project at energy facility on California-Arizona border. Project Manager and Principal Paleontologist. 2012. Subconsultant to Parus Consulting.

**Geospatial Paleontology Database.** Managed paleontological research and GIS database development for 15 counties in central and eastern California. Delivered detailed information about potential fossil yield, geological units, prior fossils and other information at cursor click. Project Manager and Principal Paleontologist. 2011-2012. Subconsultant to URS.

**Eldorado-Ivanpah Transmission Line.** Paleontological survey and Paleontological Resources Management Plan for 71 miles of electrical lines and associated telecommunications from Eldorado, NV to Ivanpah, CA across both BLM and private lands. Project Manager and Principal Paleontologist. 2010. Prime contractor.

**Mojave Water Agency Ground Water Replenishment Project.** Cultural and Paleontological Resources Management Plan was prepared, including an updated assessment, and submitted to SHPO. Cultural resources awareness training provided to all construction personnel and both archaeological and paleontological monitoring performed. Principal Archaeologist and Paleontologist and Project Manager. 2010-2012. Subconsultant to RBF.

# Attachment B: Page Museum MOU and attachments

## MEMORANDUM OF UNDERSTANDING

**THIS MEMORANDUM OF UNDERSTANDING** ("MOU") is entered into as of this 2nd day of November 2011 by and between the Los Angeles County Metropolitan Transportation Authority ("MTA") and the Los Angeles County Museum of Natural History, including the Page Museum at the La Brea Tar Pits ("Museum") (collectively, "the Parties"), for the preservation of paleontological and archaeological resources associated with the Wilshire/Fairfax Station and other portions of the Westside Subway Extension Project alignment within two miles of the Wilshire/Fairfax Station.

## BACKGROUND

**WHEREAS**, the MTA has the responsibility under Federal and State law to recover and preserve for future scientific and educational use paleontological, archaeological, and historical resources that may be impacted by the Westside Subway Extension Project and associated records; and

**WHEREAS**, the Museum has established expertise in recovery, management, curation and research of paleontological resources and is willing to permanently curate paleontological and asphalt-related archaeological resources recovered from the Westside Subway Extension Project in asphaltic deposits associated with the Wilshire/Fairfax Station and other portions of the Westside Subway Extension Project alignment within two miles of the Wilshire/Fairfax Station and recognizes the benefits which will accrue to it, the public and scientific interests by housing and maintaining the Paleontological Resources and Records Collection for study and other educational purposes; and

**WHEREAS**, the Parties hereto recognize the mutual benefits to be derived by having paleontological and archaeological resources suitably housed and maintained by Museum;

**NOW, THEREFORE**, in consideration of the terms, conditions, covenants and performances herein contained, and other consideration the receipt and sufficiency of which is hereby acknowledged, and with the intent to be legally bound hereby, the Parties agree to incorporate the above recitals into this MOU and further contract, promise and agree as follows:

1. **MTA shall:**

a. Retain a qualified principal paleontologist (minimum of graduate degree, ten years of experience as a principal paleontologist and having demonstrated expertise in vertebrate paleontology) approved by the Museum to plan, implement and supervise paleontological monitoring, preservation, fossil recovery, fossil preparation, fossil documentation and reporting of significant paleontological resources within the areas of disturbance for the Wilshire/Fairfax Station or other portions of the Westside Subway Extension Project alignment within two miles of the Wilshire/Fairfax Station. The principal paleontologist will be responsible to ensure that all subordinate personnel are appropriately qualified.

b. Require the principal paleontologist to prepare a mitigation plan, subject to approval by the MTA and Museum, to address monitoring, preservation and, recovery of any paleontological resources. The mitigation plan shall be consistent with best practices guidelines for both field and laboratory work on project paleontological resources to meet state and federal laws and guidelines and Museum standards (Attachments 1 and 2).

c. Require the principal paleontologist to monitor all ground-disturbing activities where sub-surface soils are exposed. The areas to be examined will be determined based on project plans and in consultation with construction staff and the qualified paleontologist during pre-construction meetings and as needed throughout the construction process.

d. Ensure that if subsurface paleontological resources are identified by the principal paleontologist during construction, all construction activities in the area of identified paleontological resources will be temporarily halted so that the resources may be documented and recovered. All resources shall be documented on appropriate forms approved by the Museum and these will be placed on file in the Museum.

e. Ensure that any paleontological resources, including asphaltic deposits containing fossils and/or archaeological objects, will be recovered in accordance with best practices outlined by the Museum (Attachment 1).

f. Require that the principal paleontologist have designated and secure space sufficient to store and, if necessary, analyze and process boxed or individual fossil deposits for preparation [but see section 2.c].

g. Require that the principal paleontologist record all data and, if necessary, perform excavation of boxed deposits or individual fossils, prepare fossils and store fossils prior to curation in accordance with best practices outlined by the Museum (Attachment 2).

h. Require that the principal paleontologist provide periodic progress reports including copies of all field notes to the MTA and Museum in addition to a comprehensive final report meeting all state and federal standards. The original copies of the field notes will be archived in the Page Museum at the time that the fossils are transferred to its jurisdiction.

i. Provide funding for required fossil recovery, cleaning, preservation, curation and storage and any other fossil-related Museum activities specified in Paragraph 2 based on a cost per amount recovered to be agreed upon by the MTA and Museum in a subsequent detailed Agreement to be signed between the MTA and Museum during further Project Design. Such agreement will be based in part on the Museum's cost for processing and storage of its Project 23 materials, taking into account the possible variation in the density of fossils and in the matrix in which the fossils are found. Such agreement should include contribution to cost of permanent storage premises in the event that significant quantities of fossils are recovered. Such agreement shall prevent unreasonable payment if few fossils are found, but assure payment for vital effort.

j. Allow the Museum to be involved, in an oversight capacity, for all field and laboratory work to ensure that Museum standards are being maintained.

k. Require that paleontological resources be removed expeditiously to allow Project completion according to schedule, but in compliance with Museum standards as recently demonstrated in the construction of the new LACMA Underground Garage and corresponding Project 23 Paleontological Project.

l. Retain responsibility for compliance with all legal and regulatory provisions related to monitoring, reporting, consultation, and repatriation of Native American remains and related material, including under NAGPRA and California law.

m. Assign an MTA Representative to make any further revisions or adjustments to this document necessary in the course of the project, in cooperation with the Museum.

n. Designate the Museum as the sole source for the scientific description of fossils and artifacts recovered from the Westside Subway Extension Project in asphaltic deposits associated with the Wilshire/Fairfax Station and other portions of the Westside Subway Extension Project alignment within two miles of the Wilshire/Fairfax Station. Publicity concerning the discovery of such fossils and artifacts shall be jointly undertaken by MTA and the Natural History Museum of Los Angeles County.

2. **Museum shall:**

a. Make available Museum personnel to provide oversight for the qualified principal paleontologist's preparation of a mitigation plan, subject to approval by the Agency, to address monitoring, preservation and, recovery of paleontological resources. The mitigation plan shall be consistent with best practices guidelines for both field and laboratory work on project paleontological resources to meet state and federal laws and guidelines and Museum standards (Attachments 1 and 2).

b. Make available Museum personnel to provide oversight of all field and laboratory work on paleontological resources for the duration of the project to ensure that Museum standards are being maintained.

c. Provide an option, dependent upon the volume and number of fossils recovered, that the Museum will directly house boxed fossil deposits and internally perform excavation and preparation of those deposits for compensation comparable to that offered to the principal paleontologist for similar services.

d. Provide for the professional care and management of the curated paleontological resources associated with the Wilshire/Fairfax Station and other portions of the Westside Subway Extension Project alignment within two miles of the Wilshire/Fairfax Station.

e. Ensure that personnel assigned responsibilities related to the Westside Subway Extension Project are qualified museum professionals whose expertise is appropriate to the nature and content of the paleontological resources recovered.

f. Provide and maintain a repository facility having requisite equipment, space and adequate safeguards for the physical security and controlled environment for the paleontological resources (but see 1.i).

g. Perform those conservation treatments necessary to ensure the physical stability and integrity of the paleontological resources prepared by the principal paleontologist.

h. Curate the paleontological resources to ensure adequate scientific documentation of the circumstances of their recovery.

i. Credit the MTA when the Collection or portions thereof are exhibited, photographed or otherwise reproduced and studied in accordance with the terms and conditions of Museum policy with the statement: "In Cooperation with the Federal Transit Administration and Los Angeles County Metropolitan Transportation Authority". The Museum agrees to provide the Agency with copies of any resulting publications.

3. **Paleontological Advisory Board**

The Parties agree to mutually appoint a three person Paleontological Advisory Board comprised of appropriately qualified paleontologists to help guide this effort as previously agreed by the Parties in their Paleontological MOU for this site in 1983.

4. **Amendment**

This MOU may be revised by issuance of a written amendment signed and dated by both parties.

5. **Donation of Paleontological and asphalt-related Archaeological Resources**

Agency agrees to donate title to all paleontological and asphalt-related archaeological resources to the Museum.

**IN WITNESS WHEREOF**, the Parties hereto have executed this MOU.

Jane G. Pisano

Dr. Jane Pisano
President and Director
Los Angeles County Museum of Natural History

10/25/11
Date

Arthur T. Leahy

Arthur T. Leahy
Chief Executive Officer
Los Angeles County Metropolitan Transportation Authority

11-02-11
Date

**ATTACHMENTS**

Attachment 1. Paleontological Methods for Mitigation of Fossils in the Vicinity of Hancock Park

Attachment 2. Techniques for Excavation, Preparation and Curation of Fossils from the Project 23 Salvage at Rancho La Brea

Attachment 3. Wilshire/Fairfax Station Construction Methodology

# Paleontological methods for mitigation of fossils in the vicinity of Hancock Park.



Images courtesy of ArchaeoPaleo Resource Management, Inc.

**2011**

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# Introduction

Rancho La Brea is the world's richest Ice Age fossil locality, yielding well over 3 million fossils and representing more than 600 species of animals and plants that lived in the Los Angeles Basin between 11,000 and 50,000 years ago. The asphaltic fossil deposits generally occur in randomly distributed inverted cone-shaped masses between 10 to 35 feet in depth. The sizes of the accumulations vary considerably from less than 5 cubic feet to more than 20 cubic feet. Flat tabular deposits such as that recovered during the construction of the Page Museum are rare. Ideally, the fossil accumulations should be carefully excavated as they are discovered. The fall back position is to remove the deposit intact, preserving it for excavation at a later date. This methodology, developed during the mitigation of the LACMA underground parking structure, preserves stratigraphic integrity, permits less hurried excavation under more optimum conditions, maximizes fossil and information retrieval, and enhances opportunities for major discoveries and new scientific contributions. All data pertaining to the location and condition of newly discovered fossil deposits must be recorded and photographed as outlined later in this document.

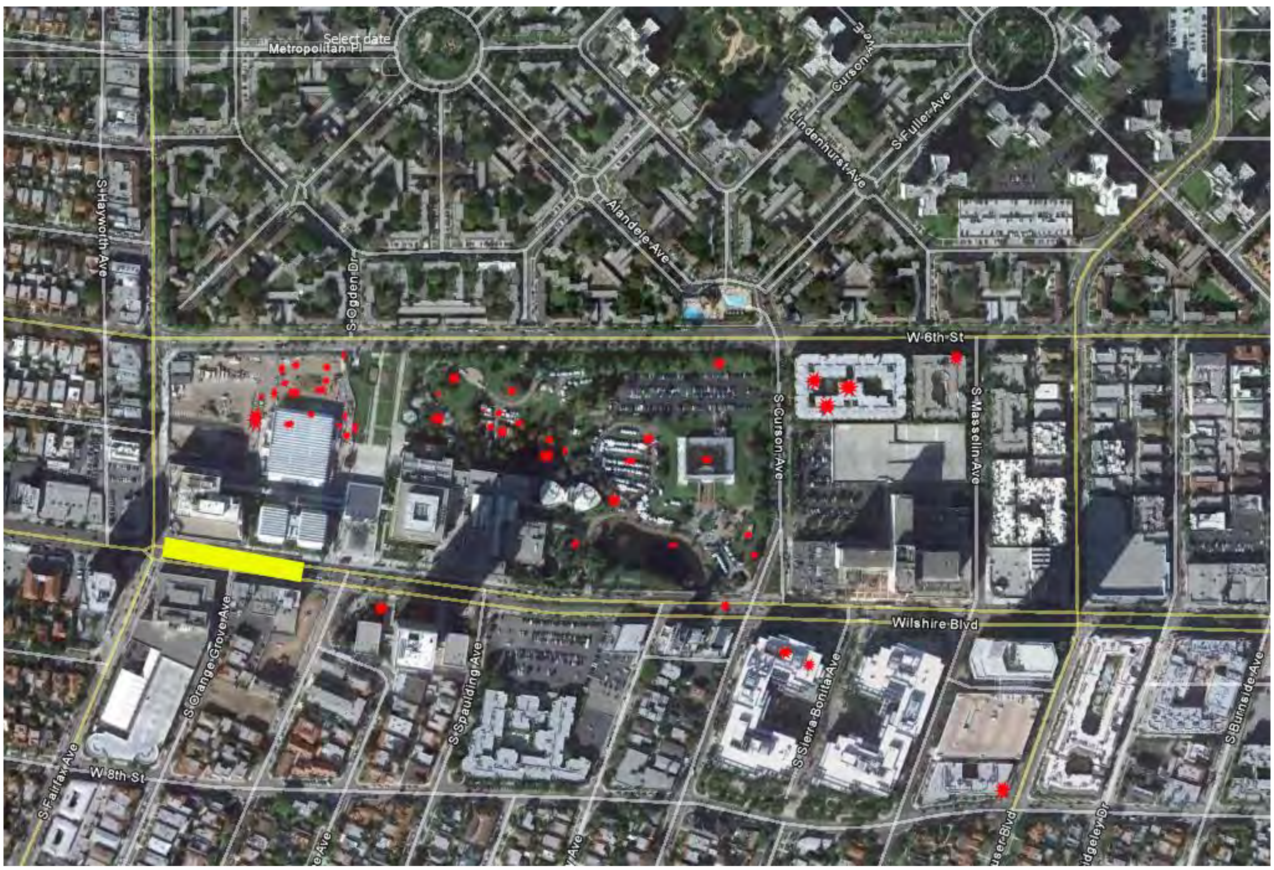



**Fig 1: Map of Hancock Park** and vicinity with known asphalt preserved fossil localities (red stars) and the approximate location of the proposed MTA subway station (yellow rectangle)

## Fig 2: Monitoring

All excavation activity must be carefully monitored. In areas of asphaltic sediment or other areas where fossils have been discovered, sediment should be removed in 4-6” levels while paleontologists monitor closely. The monitors are empowered to halt the process as soon as fossils are located.

**Fig 3: Fossils are discovered**

After a fossil deposit has been located the surrounding area must be roped off so that paleontologists can determine the extent of the deposit or if it is an isolated fossil. In the case of an accumulation deposit this may range from 5 feet to 20 or more feet across. Construction work in the immediate vicinity of the fossil deposit must be halted temporarily but may proceed normally elsewhere in the construction site. Asphalt saturated conical shaped deposits and isolated fossil mitigation are described separately below.

## Taking Field notes

Whether an accumulation of fossils are discovered or an isolated fossil is found, detailed field notes must be taken. The precise locality of each fossil deposit must be recorded with a resource-grade GPS device, its extent clearly described, mapped, and photographed on site using conventional field data collection methods, and its context including represented lithologies and depositional environments must be described. Types of geologic information to be collected should include: the nature of bounding contacts (erosional, sharp, gradational), thickness, geometry, grain size, shape, and sorting, color (fresh and weathered, use a color chart), sedimentary structures (physical and biogenic), cement type, pedogenic features (rooting, nodules, slickensides, etc.), halos, mineral crusts, microstructures around bio-clasts, and other fossils. Types of taphonomic information to be collected should include: taxonomic

representation, skeletal articulation and association, scale and geometry of assemblage, density, and orientation of bones. Bone modification information to be collected should include: weathering, polishing, abrasion, scratch/tooth marks, root traces, borings, fragmentation/breakage, and distortion. Each isolated fossil and each individual fossil deposit must be given an individual field number. This number should be written in permanent ink on individual fossils and clearly marked in permanent marker or paint on the box containing a deposit.

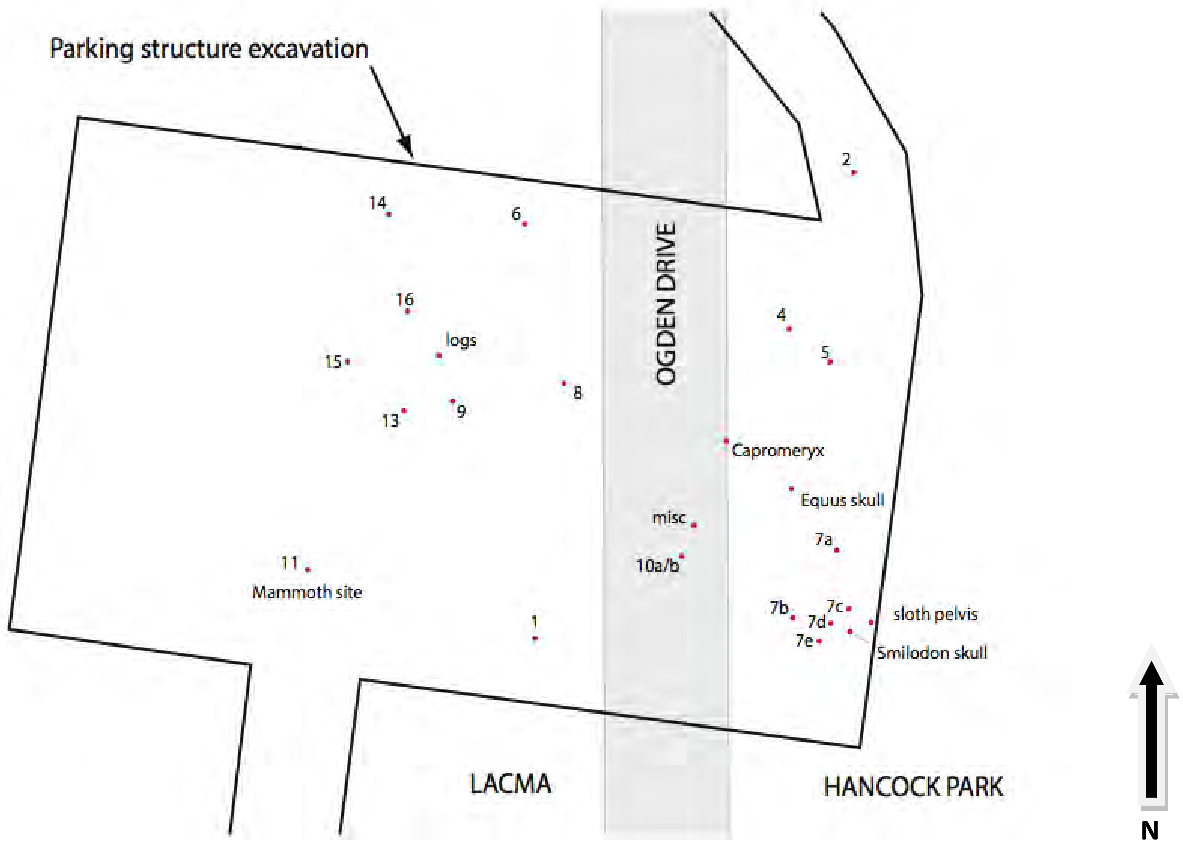
## Asphalt saturated conical shaped deposits

### Fig 4: Pedestal a deposit

Once the extent of the fossil accumulation has been determined, the sediment surrounding the fossiliferous deposit is carefully removed, isolating the accumulation on a pedestal. It may be necessary for monitors to wear a SCBA, as in this image, because of the high concentrations of hydrogen sulfide.

**Fig 5: View of east end of LACMA construction site**

It is possible that there will be a number of fossil deposits within the construction site. Work may continue at non-fossiliferous locations while the deposits are being salvaged.




## Fig 6: Map of fossil localities from LACMA parking garage

These were mostly asphaltic fossiliferous masses but included some occurrences of isolated bones, trees, and other fossils.


## Fig 7: Fossil accumulation pedestals before tree box

After the deposit has been isolated it will be surrounded by metal bands to conserve its integrity before the box is built and a brightly colored strong plastic or a tarp to keep the deposit dirt separated from the ‘fill’ dirt.

## Fig 8: Building a tree box around a fossil deposit

A custom sized box is then built around each deposit by a 'tree boxing' company. Valley Crest was used on the LACMA project.  Any space between the plastic-wrapped deposit and the edge of the box must be filled with polyurethane foam, distinctly different sediment or gravel to preserve the integrity of the deposit and to prevent its deformation during subsequent transportation and storage. It is important that the 'fill' sediment be easily recognizable from the matrix during later excavation of the deposit.

**Fig 9: Secure the tree box with metal bands**

After the sides of the box are nailed into place, metal bands are added to secure and strengthen the sides of the box.


## Fig 10: Tunnel under the tree box

After the sides of the box are secured and banded, the sediment beneath the box is removed by tunneling so that the box floor can be constructed. The field number and locality data must be clearly written on the outside of the box in permanent marker or paint. The orientation of the box and the depth below datum of the top and bottom of the deposit must also be clearly and permanently marked on the box, as well as added to the field notes for that deposit.


**Figs 11, 12 & 13: Relocating the tree boxes by crane and truck**

A crane is used to lift the completed boxes, load them onto a flat bed truck, and to relocate them to the place where their excavation will take place.

## Isolated fossils

In addition to conical and flat tabular asphaltic accumulations, construction activities may encounter isolated fossils in non-asphaltic or asphaltic sediments such as the trees, mammoth skeleton, and bison and horse skulls that were discovered during the recent construction of the LACMA's underground parking structure. Similar procedures pertain. The area must be roped off in order for the monitors to determine the extent of the fossil occurrence, which may then be removed using conventional paleontological field techniques.  Large or fragile bones must be pedestaled (with sediments immediately surrounding the fossil) and covered in a plaster and burlap jacket. The type of plaster used determines the time it takes to dry. Once the plaster is dry, it is flipped over and the other side is covered with plaster and burlap and left to dry completely. In the meantime paleontologists need to determine the extent of other isolated fossils in the area looking in particular for other elements of the skeleton of the jacketed specimen or sediments in which microfossils such as rodent, bird and reptile remains may occur.

It is crucial; that all isolated fossil occurrences be given a field number, their location recorded with a resource-grade GPS device, and these data entered into the field notes together with a map and description of the fossil, its orientation and its locality including description of the lithology in which the fossil was preserved. Standard guides such as Munsell Soil Color Charts should be used. The field number should be clearly and permanently affixed to the fossil and written on its container or jacket as appropriate. Maps must have a legend and scale to the show the orientation and depths of each fossil as well as a datum point. In addition to the field number, plaster jackets should also be marked "field side up" on the appropriate surface.

## Fig 14: Excavating isolated fossils

Paleontologists need to excavate around large bones with hand tools before covering them with a protective plaster jacket for later removal and transport.

## Fig 15: Mammoth discovered

This image show the mammoth locality in the context of the construction site during the LACMA underground parking garage.

# Techniques for excavation, preparation and curation of fossils from the Project 23 salvage at Rancho La Brea.

A MANUAL FOR THE RESEARCH AND COLLECTIONS STAFF OF THE GEORGE C. PAGE MUSEUM



2011

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# Introduction

This document was compiled mid project to record and codify best practices for excavation, preparation and curation of specimens from Project 23 and other Rancho La Brea localities that are housed in the George C. Page Museum. Some of the techniques are similar to Pit 91 excavations that were reported by Shaw (1982) and others that are unique to Project 23 because of the nature of the salvage. This provides guidelines for possible future salvage efforts. Documents discussing the nature of the mitigation are available elsewhere.

# Excavation Techniques for Project 23

Excavation of Project 23 deposits began in August, 2008. The measuring techniques used to determine and record data for *in situ* specimens follow those of Shaw (1982) for Pit 91 with some modifications described here (for instance, the imperial measurement system was used prior to Project 23). New excavation procedures have also been devised as a result of the removal of the deposits from their original location due to construction.

In Project 23, a custom-sized wooden box was built around each isolated plastic-wrapped deposit by a 'tree boxing' company (Valley Crest was used for this particular project). Any space between the deposit and the edge of the box was filled with either polyurethane foam or sediment to preserve the integrity of the deposit and to prevent its deformation during subsequent transportation and storage.

Because the deposits are no longer *in situ*, all excavation grids are oriented with respect to the deposits' original north orientation. Where feasible, box walls may be removed in part or in their entirety to allow excavation from the side of the deposit rather than from the top. Each "tree box" from Project 23 is treated differently depending on the type of deposit, size of the box and integrity of the sediments in the box. Refer to paleo mitigation protocol and ArchaeoPaleo report documents for descriptions on how the 'tree boxes' were constructed.

## Preparing a tree box for excavation

First read all the field notes pertinent to that particular deposit. In a field notebook or deposit logbook document the nature of the "box" size, construction, fill, plastic, etc. If the box is taller than 5 feet, erect scaffolding for excavators to safely access the box. Depending on the size of

the tree box it may be necessary to construct a safety railing extending upward from the sides of the box. After the top of the box is safe to access, remove the metal bands that are strapped across the top of box. Use specific snips if recommended by the tree boxing company. Remove supportive fill dirt, foam and plastic to reveal deposit surface, taking care to maintain an appropriate area for excavators to work safely.

Depending on box stability and size, board walls or portions of board walls may be removed to enable excavation from the side of the deposit. Smaller boxes containing deposits with cohesive sediments may allow the removal of all sidewalls. For larger boxes, removal of one wall or a small "window" cut into a sidewall may be feasible.

Before any asphaltic sediment is removed, set up a gas monitor close to where work will be conducted. The Solaris Multigas Detector is an economical, 4-gas instrument providing simultaneous detection of CO, O2, H2S and combustible gas and costs ~$600 from Safety Tek Industries.

## Grid layout

Determine the deposit's north side from field data and data written on the box.

Establish a datum point near the top of the box and record it based on field data. The datum point should not be removed during excavation.

Lay out grids into 1m x 1m squares with origin in the SE corner of the box using an alphanumeric system (N/S = A-Z; W/E = 1, 2, 3). Gridlines can be marked with string, spray paint or chalk and need to be refurbished and maintained periodically. A map of the box showing the grid lines and a north arrow should be drawn for reference.

## Excavation and Documentation

After grids are established, clean surface to remove fill dirt, to determine sediment type and to locate fossils if exposed. Note nature and location of fossils (bones, shells, plant remains, etc.)

Excavate grids in 25 cm spits (i.e. Level 1=0cm-25cm, L2=25cm-50cm, etc). If multiple grids are worked on at the same time, ensure that this doesn't compromise the mapping of each spit wall and floor. If a deposit has been exposed from the side, the spits in any one grid may be excavated sequentially from the top to the base of the deposit.

Depending on degree of consolidation, use small hand tools (hammers, chisels, and screwdrivers as required) on non-fossiliferous areas. Pneumatic or electric hammers can be used on areas with hard matrix where there are no fossils. Use dental picks and small screwdrivers to expose and extract fossils. Hard asphaltic matrix can be softened with clamp lamps or loosened with a small amount of solvent. Measure exposed fossils *in situ* (see below) within each grid and record their data in field notes before extracting them.

Note: Clamp lamps should be placed at least 8" away from the specimens and always monitored. Never leave lamps unattended. If the sediments start to smoke immediately turn off the lamp. 150 watt incandescent unfrosted bulbs should be used.

Save all of the surrounding sediments but separate them based on sediment type into 5 gallon metal buckets with lids. The pre-designated sediment types are A= asphaltic sand, B=brown silts and C=clay. Mark each bucket with box #, grid and level data as well as the sediment type (A, B or C). Note the number of buckets of each sediment type from each grid on an inventory list kept by the lead excavator. This is important because it determines how each bucket is processed later (see matrix processing section).

Keep daily documentation in field notes of who is excavating, a list of the grid or grids being excavated and describe the type of matrix being removed, what is being found within each grid, and any challenges encountered with the excavation. Geologic and paleobiological data should be recorded in field notes for later use to constrain and further refine taphonomic, paleoenvironmental, and paleobiological interpretations. A description of each lithology (soil type) should include color (fresh and weathered), lithologic composition, grain size, sorting and shape, sedimentary structures, induration, type of cement, fossil content, and pedogenic features (rooting, nodules, slickensides, etc.). As excavation proceeds note unit thickness, nature of the bounding contacts (erosional, sharp, gradational), and inferred depositional setting. Note nature and location of fossils (bones, shells, plant remains, etc.). Any visible modifications to the bones (weathering, polish, abrasion, scratch/tooth marks, root traces, borings, pitwear, breakage, distortion) and gross orientation should be recorded. Features of the matrix surrounding the bones, such as alteration halos, mineral crusts, micro-structures, fine root traces (small burrows or borings), and localized invertebrate bioturbation should be noted. The degree and nature of articulated, semi-articulated, associated, and dissociated skeletal elements should be described. Notes should also be taken on the general geometry of the fossil deposit (vertical pipe, tabular, etc.) drawings and/or photographs should be taken when appropriate.

## Measurement system

The most common types of macrofossils recovered from asphaltic deposits are isolated bones. The following measurement system has been devised for capturing data for individual bones.

See the Special Cases section for the treatment of associated skeletons, dermal ossicles, plant masses, etc.

*In situ* measurements are taken from specific anatomical points on each bone (see Table 1 and 2 Appendix A) to define its spatial orientation with reference to its depth below an established datum point (BD), its distance north (N) of the southern grid line and its distance west (W) of the east grid line using the metric system (see Fig 1. of Shaw (1982) but note this uses the imperial measurement system). Recording this data at the time of excavation will facilitate studies of stream current energy and direction, deposition, and taphonomy.

All identifiable bones from 1 cm to 2 cm in size should be measured *in situ* as a 1-point measurement before being excavated. Each Standard Measurement (BD, N, W) is taken to the center point of the longest dimension (Fig. 3)

Bones larger than 2cm in minimum length or diameter should be measured as either a 2-point or a 3-point measurement. The 3-point measurement is used on all bones in which three predetermined identifiable anatomical points are visible. The 2-point measurement is used if the bone lacks three distinct reference points and records the orientation of the long axis of the specimen (proximal-distal, anterior-posterior, medial-lateral, etc.). Detailed instructions for measuring out specimens are provided by Shaw (1982), which also lists the elements that generally fall into each of these categories.

All the data pertinent to the specimen should be recorded in the field notebook and should also accompany the specimen until its preparation and curation have been completed. One method of doing this is to duplicate the field notebook entries onto a 3” x 5” card using carbon paper (Fig 1, 2 and 3 below). This card then accompanies the specimen throughout its preparation, curation, and final cataloging. Only when the data have been recorded in the catalog are they separated.

In addition to measurements on individual bones, the dip of all limb bones and skulls should be recorded with a Brunton compass. Recording these data at the time of excavation will assist with interpretation of stream current energy and direction, and taphonomy which may include possible vertical movement in a vent, trampling, etc.

The soil type surrounding each measured bone should also be noted on the 3” x 5” card by a letter using a pre-designated lettering system. The pre-designated sediment types are A= asphaltic sand, B=brown silts and C=clay.

After a bone has been measured *in situ*, it is placed in an appropriate sized clear plastic bag. The 3” x 5” data card is placed in its own small clear plastic bag for safety and then placed in the bag with the bone.

**Fig 1: Example of excavation data for a 3-point measurement in a field notebook and transcribed onto a 3" x 5" card template.**

P23-14 B3/L4

| | GT | Px | Dt |
|---|---|---|---|
| BD = | 58cm | 53cm | 64cm |
| N = | 31cm | 35cm | 31cm |
| W = | 13cm | 10cm | 90cm |

*Canis dirus* femur

Soil type= A
Dip=30°SW
Excavator initials and date

**P23-14 = Project 23-Box 14**
**B3/L4 = grid B3/level 75cm-100cm**

**GT = Greater Trochanter is 58cm below datum, 31cm from the south grid axis and 13cm for the east axis**
**Px = Proximal end is 53cm below datum, 35cm from the south grid axis and 10cm from the east axis**
**Dt = Distal end is 64cm below datum, 31cm from the south axis and 90cm from the east axis**

**Soil type A= asphaltic sand**

**Fig 2: Excavation data for a 2-point measurement in a field notebook and transcribed onto a 3" x 5" card template.**

P23-1 B1/L2

| | Px | Dt |
|---|---|---|
| BD = | 53cm | 64cm |
| N = | 35cm | 31cm |
| W = | 10cm | 90cm |

Canid juv. radius

Soil type= B
Dip=1°SW
Excavator initials and date

**P23-1 = Project 23-Box 1**
**B1/L2 = grid B1/level 25cm-50cm**

**Px = Proximal end is 53cm below datum, 35cm from the south grid axis and 10cm from the east axis**
**Dt = Distal end is 64cm below datum, 31cm from the south axis and 90cm from the east axis**

**Soil type B= brown silt**

**Fig 3: Excavation data for a 1-point measurement in a field notebook and transcribed onto a 3" x 5" card template.**

P23-5B D3/L7

BD = 20 cm
N = 10cm
W = 15cm

Rodent tooth

Soil type=C
Excavator initials and date

**P23-5B = Project 23-Box 5B**
**D3/L7 = grid D3/level 150cm-175cm**

**20cm below datum**
**10cm from south gridline**
**15cm from east gridline**

**Soil type=clay**

Specimens smaller than 1 cm, fragments, or unidentifiable smaller bones are placed into "bulk matrix bags" together with field data cards (P23-deposit # and grid/level information, excavator initials and date). Because they are known to contain fossils, the bulk matrix bags will be processed before the rest of the matrix samples. Keep associated fragments together in capsules or envelopes within the bag. Be sure to always place delicate bones into snap cap vials first and then into a clear plastic bag with their data. If a fossil is not in place, identify it and label it "not *in situ*"

## Special cases

Each special case requires consultation by lab and collections staff to assess the best way of documenting each potentially unique occurrence.

- An articulated or associated skeleton should be extensively photographed. If, after consultation with Lab and collection staff this is removed as a small block, be sure to place a white pin in the top surface along the northern middle portion of the block so that it can be oriented later. Draw and annotate a diagram of the block and the elements that are visible on each surface before it is removed. Measure out the block as a 2-point measurement. Elements within the block that can be identified and measured without compromising the specimens should be also noted and can be measured using the 1 or 2-point measurement system but should not be removed from the block. Labeled copies of all photographs should be placed in the bag with the specimen. This is additional to downloading the photographs to the archive computer (see photography section). Articulated or semi-articulated specimens should be extracted in articulation and the sediments around the specimens stabilized to conserve the maximum amount of information derivable from the specimen.

- Bone masses with poorly preserved specimens (fragmented and/or less asphalt-impregnated) are more difficult to measure out individually. Measure out the extent of the mass with the 2-point system rather than the constituent bones. Place a white pin in the top surface along the northern middle portion of the block so that it can be oriented later. Photograph in situ specimens, print and label images and place them in the bag with the specimens.

- As instructed by Lab and collections staff, and depending on their nature and frequency, dermal ossicles and pockets of plant, shell or insect material should either be measured out as a small block with a 2-point measurement (same as above) or placed in pre-labeled bags with locality information for a specific 10cm square within the 1m x 1m grid.

## Geologic Samples

Collect 15 cm by 15 cm soil samples of each sediment type from each grid and level for geologic analysis of composition, weathering, and grain size at a later date. Document each sample in your notebook and measure each one *in situ* as a block using the 2-point measurement system used for fossils and described above. Each sample should have a white pin placed on the upper surface in the northern middle portion of the sample so that later the sample can be oriented. Transcribe all data onto a 3” x 5” card and place in a clear plastic bag with the soil sample. A list of soil samples taken should be kept by the lead excavator for each grid and deposit.

When spits are completed, photograph and map each exposed wall and the floor.

## Floor and Wall mapping

When mapping a wall or floor (Fig. 4, 5 and 6)

- Draw maps on graph paper with a scale of 3 squares = 10 cm.
- Keep the origin point (0, 0) in the southeast corner.
- Mark north arrow.
- Draw in empty spaces and the edge of the box when present.
- Mark asphalt and sediment contacts.
- Use standardized symbols for lithologies and other known sedimentary features. Also
- Indicate where fossils, cobbles, bone, shells and plants masses are located (Fig 4).

**Figure 4: Standard symbols used in mapping each grid's floor and wall**

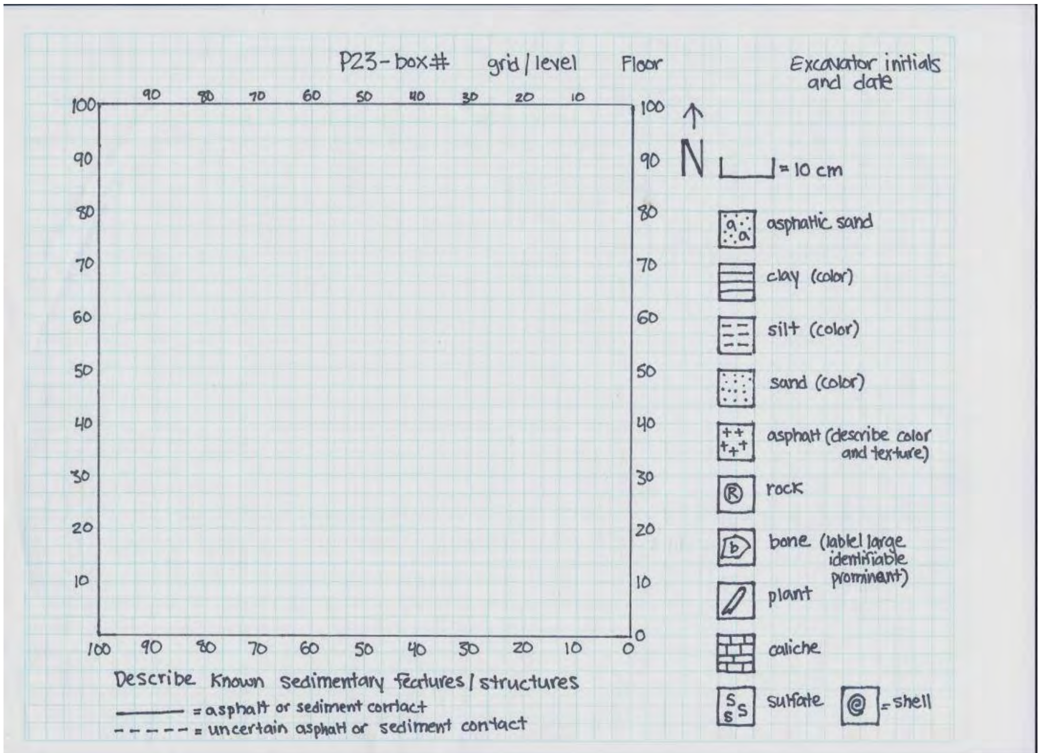



**Figure 5: Sample drawing of the floor of grid C3/L3 of box 14**

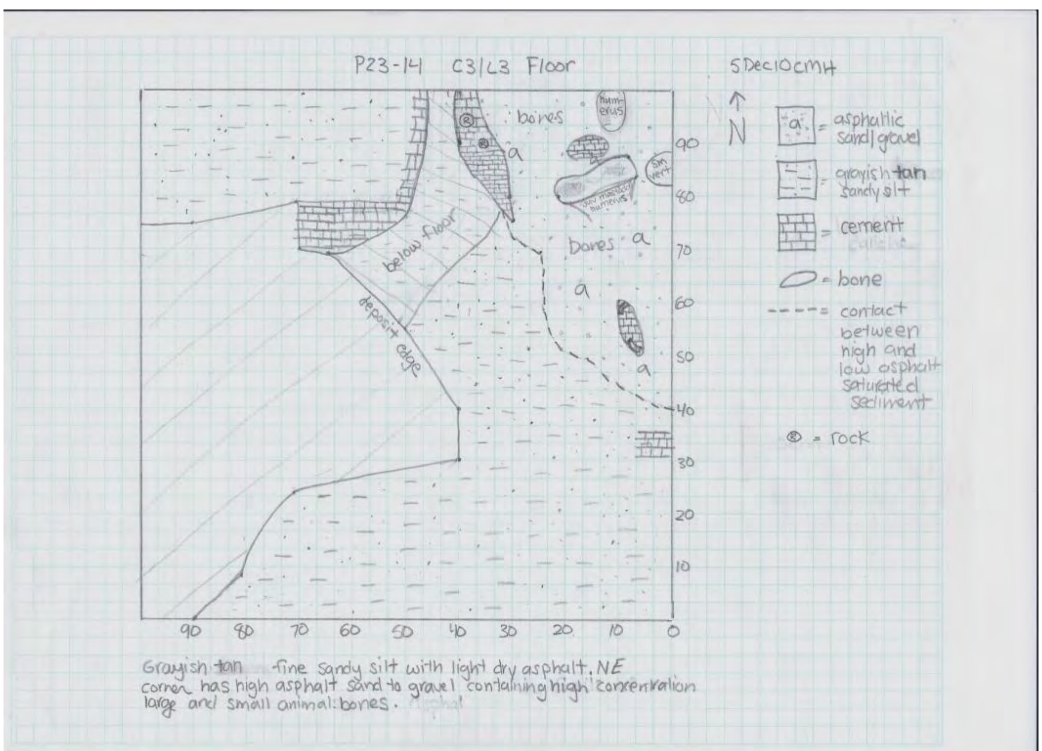
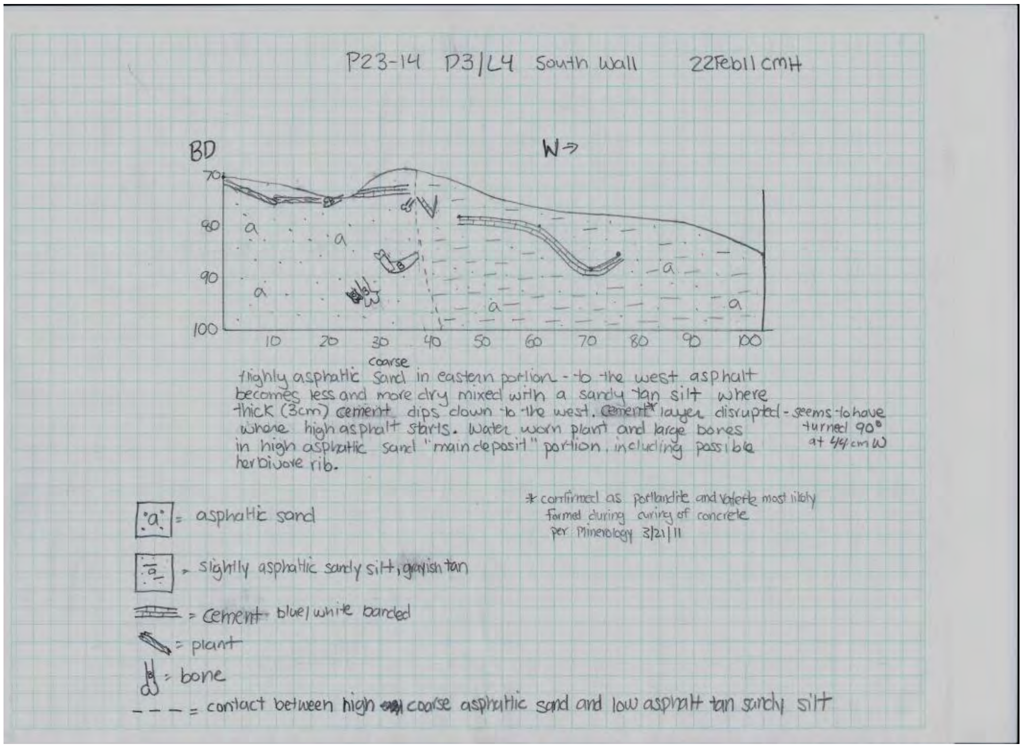


**Figure 6: sample drawing of the south wall of grid D3/L4 of box 14**




## Photography

Photo documentation and the labeling of downloaded images are very important. In the field photo logbook provided, record all the images that you take. This is shared by everyone and has columns for name of photographer, date, box #, grid and level, orientation of image, file number and special notes. Take a photograph whenever it might be useful for lab staff and researchers to see how a specimen was oriented in the ground, broken in a certain way or for any other unusual circumstance. Always photograph the floor and each wall of a grid before starting a new one.

<u>When photographing a specimen:</u>

Write the project name, box #, grid and level #'s, orientation, description of what you are photographing, the date and excavator initials on a 3"x 5" card with a black sharpie and place next to the object you are photographing.

For example:

| |
|---|
| P23-14 C3/L3 |
| Skull , ventral view ↑ |
| N |
| Excavator initials and date |

Print the photo as soon as possible and place it in the bag with the specimen. This may not be necessary for all the images of *in situ* specimens, so make a judgment call here.

<u>When photographing a floor or wall:</u>

- Write the project name, box #, grid and level #'s, orientation, the date and excavator initials on a 3"x 5" card with a black sharpie.

For example:

| |
|---|
| P23-14 C3/L3 |
| South Wall ↑ |
| Excavator initials and date N |

- Place meter sticks in north and west orientation.
- Take a picture of each exposed wall and floor with the card and meter sticks in frame so as not to cover up any significant features and so the information on the card can be used to tag the photograph in the database.

Download all photographic images to the archive computer and place in the folder "to be sorted" under My Pictures\Project23 under the project 23 login. Rename your files appropriately so that they can be retrieved, tagged in Adobe Bridge and added to the EMu database. This is where the photo logbook will be useful. Each image should be named with the following conventions in order to be searchable in the database:

1. If it is a photo of a grid and a level then name it P23-1 B1 L2 where P23-1 refers to the Box number, B1 refers to the grid and L2 refers to the level. Notice a space between P23-1 and B1 and also between B1 and L2. This is on purpose and helps the database find the files. If there is no level just enter the information that you have.
2. If it is just an image of several grids just name it with the box number e.g. P23-14.

3. If it is a photo of a possible associated skeleton or a specimen in the ground include some more information such as what it might be e.g. P23-1 B1 L2 bird skeleton

## Data entry of field notes

Write field notes in pre-bound notebooks. For each day compile a daily journal that includes notes on the weather, who was working, general work done that day, grids being worked on, etc. as well as geological information on open grids and specimen measurements. On a weekly basis all excavation notes, photographs and grid drawings will be captured electronically.

- Type journal entries into word documents with each day saved as a new file. The naming convention of the file should be "project yearmonthday initials" (e.g. P23 20090201 ABF). Within the word doc file at the top of the page type the initials of the excavator and the date. This serves as a search tool for the database. Save these to the flash drive that is provided. The Collections Manager will import these data into the database.
- Type specimen measurement data into a pre-prepared Excel spreadsheet and save to the flash drive provided. The Collections Manager will import these data into the database.
- The floor and wall drawings and photographs for each grid must be scanned and downloaded onto the archive computer at the Page Museum.

## Matrix processing

There are two different ways that matrix from the excavation is processed. All asphaltic matrix from or adjacent to asphaltic bone concentrations needs to be processed with solvent in a vapor degreaser in order to release small bones and other plant, insect, invertebrate and vertebrate remains from the asphalt. After degreasing, the matrix is dried and dry screened to remove the clay-to-silt fraction. The remaining concentrate is sorted for microfossils under a microscope.

Samples of other (apparently non-fossiliferous) non-asphaltic sediments are screen-washed in water on 20 mesh screens and the concentrates are sorted for microfossils under a microscope. If there is no evidence of microfossils in the sample, the remaining material from that facies of that grid may be discarded (except for the 15 cm archival cube that was collected during excavation of the grid).

# Laboratory Protocols

All material sent to the Lab for cleaning is triaged to resolve appropriate methodology, account for the skill level of available lab workers, and for research and collection priorities. An n-propyl bromide solvent is used to remove asphalt from the bones. Trade names for this solvent include Lenium, GenTech and EcoMax. Elmers white glue is used to repair broken bones and Acryloid (Paraloid) B-72 (Ethyl methacrylate copolymer) is occasionally used to consolidate dry bones.

## Prioritize new specimens

1. For cleaning method
   - Sort and store by locality, grid, depth.
   - Sub-sort by best cleaning method: ultrasonic, soaking, or hand prep.
2. For significance
   - Rareness of taxon
   - Incomplete section of previously excavated specimen
   - New element of known individual skeleton from that locality
   - Unrecognizable to element or taxon.

## Ultrasonic cleaning

Ultrasonic cleaning can be used for the following types of specimens:

- Complete or sturdy bones measured in individually (examples include *Smilodon* or *Canis dirus* carpals, tarsals, phalanges)
- Complete or mostly intact avian bones. The feasibility of processing other fragile bones, including broken small bones, should be assessed by the person who will be re-assembling them.
- Shells, insects, and concentrations of mollusks or insects from within known locality with measurements.

**Steps to be followed**

1. Place each specimen or sample in a baby food-sized jar with all contents of envelope.
2. With pencil, number the envelope and the top of the jar (on masking tape).
3. Prepare six jars as above.
4. Fill with solvent to an equal level in all jars.
5. Place in ultrasonic tank and fill with water up to the level of solvent in jars.
6. Buzz for fifteen minutes.
7. Strain contents of jar through 20 mesh screen on top of pitcher.
8. Rinse with clean solvent.
9. Check specimen or sample for matrix, detail with brush or skewer as needed.
10. Place each specimen or sample on separate paper tray, with flipped out matrix, data, and masking tape number from jar top.
11. Let dry over night, polish, and sort matrix.
12. Solvent that was strained into pitcher can be reused for setting up next batch of six jars if not too dirty.

## Pre-soaking

- Large bone masses: If there is no single identifiable bone, put it in a large jar or a bucket with more solvent than volume of mass. Mass may require a second rinse if solvent becomes too thick with asphalt.
- Unusually hard matrix: Put all of the specimen and loose matrix in jar with data taped to lid.
- Broken *in situ* specimens: If matrix is in internal structure of bone, soak and rinse.

# Hand preparation

- Individual specimens with positional data include vertebrae, ribs, long bones, etc. that are relatively complete.

**Steps to be followed**

1. Rubber stamp, date, and write the signature of preparator on back of data card.
2. Empty all contents of plastic bag or envelope into stainless steel pan.
3. Wet specimen with solvent from squirt bottle.
4. Scrub with tooth brush, dipped in small jar of solvent (n-propyl bromide)
5. DISOLVE MATRIX, DO NOT PUSH OFF WITH BRUSH OR OTHER TOOL.
6. Wood skewers or sticks can be used to loosen or nudge matrix off (If the stick breaks, the matrix is not soft enough yet)
7. When specimens appear clean, rinse thoroughly with solvent and immediately hold in front of vent for quick dry. Matrix still adhering to specimen will be black or darker than bone.
8. DENTAL TOOLS ARE TO BE USED FOR THE REMOVAL OF VISIBLE ROCKS ONLY!
9. When the entire matrix has been removed, place specimen, data card and jarred contents of metal pan matrix on paper tray lined with paper towels to dry.
10. DO NOT GLUE UNTIL ALL MATRIX IS SORTED.

- Multiple pieces of one specimen.

1. Should be prepared by one person but treated as separate projects.
2. Finished elements held until all parts are done.
3. If glued, the part that goes with which data should be recorded in pencil on back of data card.

- Possibly associated elements of one individual

1. Treat as above but can be cleaned by multiple preparators.
2. Label for possible association with a known skeleton or a single other element. [more specific].

- Skulls

1. External surfaces should be freed of larger associated specimens and gross matrix clumps using toothbrushes and solvent.
2. DO NOT POKE IN EARS, NOSE OR BRAIN CASE.
3. At the end of session, immerse in solvent in sealable bucket with copy of data on lid.
4. Soak for two or three days.
5. Hold skull over bucket and flush with clean solvent to remove loose matrix.
6. Working in metal tray, nudge with skewers to loosen softened matrix and rinse off.
7. Add removed matrix back into bucket.
8. Replace skull in bucket at end of session.
9. If the tympanic bulla is intact, nudge and rinse ear region over metal pan and process matrix separately for ear ossicles.
10. When brain case and nasal region are mostly free of matrix, skull will not need to continue to soak and can dry between sessions.
11. Strain contents of bucket.

## Polishing

- When specimen has dried overnight, go over small sections of solid bone with a dampened **soft cloth**, then go over the same space with a dry cloth. Exposed cancellous tissue should be blotted with a damp rag. Not rubbed!
- If there are small spaces that cannot be reached with a rag use a pipe cleaner or Q-tip. Dip it in solvent and blot off some liquid before applying. IF THE SPECIMEN GETS DARKER OR BEGINS TO LEAK ASPHALT, IT IS TOO WET. Put aside for a day and begin again.

## Processing Matrix from Individual specimens

- Processing sediment that has been soaked in solvent. (most common situation)

1. Pour contents through 20 mesh screen sitting on funnel into carboy.
2. Rinse with clean solvent.
3. With one motion, flip contents onto paper toweling on a paper tray.
4. Make sure everything is out of jar and out of screen.
5. Place tray near vent to dry.
6. When completely dry, sift and put in appropriate sized jar for later sorting.
7. If matrix appears clumpy after sifting, re-soak in solvent.
8. If matrix appears dirty with clay or silt after sifting, soak in hot water with a small amount (1 tsp) of detergent)

- Processing soaked in water sediment.
  1. Pour contents of jar through 20 mesh screen in a basin in the sink.
  2. Agitate the screen in clean warm water.
  3. Flip contents onto newspaper and leave screen on top to thoroughly dry.

## Microfossil sorting

When the matrix from an individual specimen is clean and dry it is ready for microfossil sorting.

Take the entire project (specimen, data and matrix) to a sorting station.

Do not pour out more matrix than you have time to sort.  Only 1½ to 2 Tbs. may take several hours.

1. Sifting
   - Always sift matrix before sorting even if it was sifted before putting in a jar.
   - Sift through a designated 20 mesh screen with 2 inch sides.
   - Shake back and forth, (not up and down) over a paper towel.

- Empty contents of screen onto a clean piece of white sorting paper and shape matrix into a pile.
- Discard the fine soil that went through the sifter.

2. Sorting

- Examine matrix, several grains at a time, by moving it across the paper with a fine paintbrush.
- Create a “discard pile” for sediment and oxidized asphalt.
- Move bone, plant, shell and insect fossils into distinct piles on one side of the paper.
- Create a “questions” pile for indeterminate fossils.
- When the entire matrix has been categorized, review fossils and “discard pile”.
- Have a staff person double check sorting.
- It may be necessary to examine some specimens under the microscope.

3. Temporary packaging of categories

a. <u>If all of the matrix of a individual project is sorted</u>

- Review bone and separate into three categories:
- 1. Broken pieces of the main bone (put aside for possible gluing);
- 2. Identifiable bones (put into individual capsules or plastic containers);
- 3. Unidentifiable bone fragments (put into one capsule or larger container).
- Review plant material (separate seeds and put into capsule) and put into glass vial.
- Review insect and put into one capsule.
- Review shell and put into one capsule.

b. <u>If only a portion of the matrix is sorted</u>

- Place complete identifiable bones in capsules.
- Place all bone fragments, plant, insect and shell into their own labeled containers.

When a large project is complete, all of the bone fragments must be reviewed and sorted to the above categories.  It will be necessary to look at the small bone fragments under the microscope to determine the final number of Identifiable bones.

## Gluing

DO NOT GLUE UNTIL ALL MATRIX REMOVAL, POLISHING AND MATRIX SORTING IS DONE.

Use white glue for reconstructing most bones because it is reversible with warm water.

If a specimen is shattered, first reconstruct it holding the pieces together with masking tape.  Do not glue until all of the fragments have been tested in available holes.  Determine where all the major fragments go first and then glue from one direction.  Have small strips of masking tape cut before the glue is applied.  Apply glue with stick or dental pick in small amounts to the broken edges.  Tape glued pieces in place and/or balance in sandbox for drying.  Allow large pieces to dry overnight.

## Envelopes for finished projects

A copy of the original data must be made for every identifiable bone and one copy each for vial containing plant, insect, shell and unidentifiable bone.  A rubber stamp template for “Found in assoc. w/” data is stamped on the face of a #5 ½ coin envelope.  An exact copy of the original is then filled in.  Note: Do not change the tentative field identification that is part of the original data even if it is wrong.  The back of the envelope is stamped with a template for the scientific identification.  If an “assoc. w/ bone “or the plant fragment is too large to fit inside an envelope, it should be put in a small plastic bag with an envelope. The envelopes are stapled shut and the entire project is put in one large plastic bag.

The finished bag should include the main bone, fragments of the main bone that could not be glued on, the original data and all the “associated with” specimens.

# Pre-Curation

After the specimens have been cleaned, the microfossils sorted and put into individual capsules and individual envelopes have been made for each specimen with all of the provenance data written on each envelope (see laboratory procedures) they are sent to the curation station. Identification of all of the fossils takes place near the comparative collection in the lab in order to facilitate identification. The principal measured out specimen with its original 3”x 5” field data card is identified first. The card is stamped on the back with a custom stamp with Scientific Name, Element, Identifier, and Notes. The specimen is identified as much as possible but identifications necessarily range from class identification such as Aves to genus and species. The identifier also describes the element according to an established list of bone terminology. Then each of the microfossils associated with that main bone are also identified in the same manner. After all of the microfossils that accompany that main specimen are identified, they are placed in a clear plastic bag with a twist tie and sent to the cataloging station. Below are detailed step-by-step instructions on how to identify specimens.

For each specimen follow the steps below in the order given.

1. Choose a specimen from the ‘to be identified’ box. If several envelopes are fastened together you must keep them together and complete the work on all of them.
2. Check the bone to see if it is clean and that all broken pieces have been glued if possible. If the bone is not clean then do not proceed with that one and send it back to the lab
3. Identify the bone using the reference collection and write the identification on the back of the envelope or card in pencil. Only use paperclips to join envelopes together.
4. Check to see if the main identified bone is in the original envelope or with the original 3” x 5” card.
5. Send identified specimen to be cataloged

- Always put the comparative bone back in the box it came from!
- if you find a ‘found in association with’ envelope which is not still with its original envelope, find the original envelope and fasten them together
- put all tools away and empty bags and containers

## Associated groups

If there is more than one specimen in an envelope the principal bone for which the measurements were recorded should remain in the original envelope. The other specimens should be treated as follows;

- all plants in one envelope
- all insects in one envelope
- all shells in one envelope
- each identifiable bone in a separate envelope, along with any of its broken pieces
- all unidentifiable bone in one envelope
- all difficult to identify bones in one envelope

Use envelopes stamped "Found in Association with" and make a complete copy of the information from the original envelope on each one.

## Identifiable and Unidentifiable Specimens

Identifiable bone characteristics:

- presence of an articular surface
- cross-sectional shape
- foramina
- distinctive curves
- relative size combined with other features

Bones are rated in three different grades of how easy they are to identify

- identifiable
- difficult to identify
- unidentifiable

Double check all identifications

## Identification of Specimens

The back of each envelope is marked with a custom stamp (stamp in bold below). Identifications are printed in pencil. An example below

- **Scientific name:** *Smilodon* (use both genus and species if more than one species)
- **Element:** prox. rt. tibia
- **Special Notes:** Pathology
- **Identifier:** ABF

1. Avoid using terms such as “frag” or “portion”. Use prox. or dist. if appropriate.
2. You must not abbreviate scientific names but you may use abbreviations for the elements as long as they are the ones listed in this manual.
3. When identifying skulls and mandibles always list the teeth that are present and if they are erupting, fully erupted or worn.
4. The format of the identification is very important. Do not invert the word sequence e.g. prox. rt. rib is correct but rib, rt. prox. is not.
5. For incomplete bones name both the bone e.g. XIII thoracic vert and either the represented part e.g. centrum or the missing portion, e.g., w/o right transverse process. Make sure that the identity of the bone and its qualifier are both listed.
6. Be specific about the identity of any represented epiphysis, e.g., proximal or distal epiphysis of a limb bone, or head epiph of lt femur or ant cent epiph of thoracic vert.

7. Ordinal numbers of ribs, vertebrae, metapodials and digits are written in Roman numerals e.g. rt. II rib or XII thoracic vert

8. Number of phalanges and teeth are written in Arabic numerals e.g. 2nd phalanx or rt. M1. Note that abbreviations for upper molars are written in upper case letters (I, C, P, M) whereas those for lower teeth are written in lower case (i, c, p, m). For clarity of handwritten entries, put a line below the number for upper teeth (e.g. P4/) and a line above the number for lower teeth (e.g. m/1).

9. The side, either left or right comes before a number e.g. rt. II metatarsal

10. There are two special cases:

    - Phalanges that can be precisely named include sloth phalanges, carnivore 'thumb' phalanges and bird carpal phalanges e.g. rt. 1st carpal phalanx, digit I

    - Teeth which can be specifically named e.g. lt. p2

11. Skull fragments: if the facial or cranial region of the skull is mostly intact this can be recorded as 'ant' or 'post' skull. However if there are only a few fragments the individual bones are named e.g. basisphenoid, occipital and rt. temporal or indicate if some parts are missing, e.g. post. skull w/o rt. occipital.

12. Juvenile specimens: it is important to note if an epiphysis is missing as the order of ephiphyseal fusion is used to detect the age of an animal. Also mark "juv." in the special notes section of the identification.

## Abbreviations chart for elements

| | | |
|---|---|---|
| Left: lt. | Posterior: post. | With: w/ |
| Right: rt. | Ventral: vent. | Without: w/o |
| Proximal: prox. | Dorsal: dors. | Juvenile: juv. |
| Distal: dist. | Medial: med. | Pathological: path. |
| Anterior: ant. | Lateral: lat. | Unidentifiable: unid. |

Difficult to identify: diff.

Zygomatic: zygo.

Epiphysis: epiph.

Diaphysis: diaph.

Tuberosity: tub.

Trochanter: troch.

Articular: artic.

Vertebra: vert.

Transverse: trans.

Process: proc.

Centrum: cent.

Prezygapophysis: prezyg.

Postzygapophysis: postzyg.

Incisor: I (upper) or i (lower)

Canine: C (upper) or c (lower)

Premolar: P (upper) or p (lower)

Molar: M (upper) or m (lower)

Deciduous: D

## Dental formulae for Rancho La Brea fauna

Dental formulae are a short hand way of indicating the number and kind of teeth that are present. The upper jaw is indicated first and the teeth are in order: incisor, canine, premolar, molar.

Ruminant artiodactyls

0,0,3,3 / 3,1,3,3

*(Antilocapra*, *Bison, Capromeryx, Odocoileus)*

Camelids

*Camelops:* 1,1,2,3 / 3,1,1,3

*Hemiauchenia:* 1,1,2,3 / 3,1,1-3,3

Peccaries

*Platygonus:* 3,1,4,3 / 3,1,4,3

Horses

*Equus:* 3,1,3,3 / 3,1,3,3

Tapirs

*Tapirus:* 3,1,4,3 / 3,1,4,3

Dogs and bears

3,1,4,2 / 3,1,4,3

*(Arctodus, Canis dirus, Canis latrans, Urocyon, Ursus)*

Cats

3,1,3,1 / 3,1,2,1

*(Felis atrox: Felis concolor: Lynx)*

Sabertoothed cats

*Smilodon:* 3,1,2,1 / 3,1,1,1

Skunks, weasels, & badgers

3,1,3,1 / 3,1,3,2

*(Mephitis, Mustela, Spilogale, Taxidea)*

Hares and rabbits

2,0,3,3 / 1,0,2,3

*(Lepus: Sylvilagus*)

Shrews

*Notiosorex:* 3,1,1,3 / 2,0,1,3

*Sorex:* 3,1,3,3 / 1,1,1,3

Wood rat, grasshopper mice, deer mice, & harvest mice

1,0,0,3 / 1,0,0,3

*(Neotoma: Onychomys: Peromyscus: Reithrodontomys)*

Ground squirrel

*Otospermophilus:* 1,0,2,3 / 1,0,1,3

Pocket mice, gophers, and kangaroo rats

1,0,1,3 / 1,0,1,3

*(Perognathus: Thomomys, Dipodomys)*

Proboscideans

1,0,3,3/0,0,3,3

(*Mammuthus, Mammut*)

Special Cases

Ground sloths (cheek teeth only)

*Paramylodon:* 4-5 / 4

*Nothrotheriops:* 4 /3

## Bone terminology

**Skull**

- Alisphenoid
- Basioccipital
- Basisphenoid
- Frontal
- Interparietal
- Lacrimal
- Jugal
- Mastoid
- Maxilla
- Nasal
- Occipital
- Occipital condyle
- Palatine
- Paramastoid process
- Paraoccipital
- Parietal
- Postglenoid process
- Postorbital process
- Premaxilla
- Presphenoid
- Pterygoid
- Squamosal
- Temporal

- Tympanic bulla
- Vomer

**Auditory ossicles**

- Malleus
- Incus
- Stapes

**Mandible**

- Angular process
- Coronoid
- Articular condyle
- Symphysis

**Hyoid**

- Basihyal
- Epihyal
- Thyrohyal
- Ceratohyal
- Stylohyal

**Teeth**

- Permanent upper and lower. Upper denoted by upper case abbreviation and lower by lower case abbreviation.
    - Incisor – I (upper) or i (lower)
    - Canine – C (upper) or c (lower
    - Premolar – P (upper) or p (lower)
    - Molar – M (upper) or m (lower)
- Deciduous upper and lower. Upper denoted by upper case abbreviation and lower by lower case abbreviation.
    - Incisor – DI (upper) or di (lower)
    - Canine – DC (upper or dc (lower)
    - Premolar –DP (upper) or dp (lower)

**Vertebra (e)**

- Atlas
- Axis
- Caudal
- Centrum
- Cervical
- Lumbar
- Neural spine
- Odontoid process
- Postzygapophysis
- Prezygapohysis
- Sacral
- Sacrum
- Thoracic
- Transverse process
- Wing

**Ribs**

- Capitulum
- Shaft
- Tuberculum

**Sternum**

- Manubrium
- Sternebra
- Xiphisternum

**Scapula**

- Acromium process
- Coracoid process
- Glenoid fossa
- Metacromion
- Spine
- Vertebral border

**Humerus**

- Deltoid tuberosity
- Entepicondylar foramen
- Greater tuberosity
- Head
- Lateral condyle
- Lateral epicondyle
- Lesser tuberosity
- Medial condyle
- Medial epicondyle

**Radius**

- Styloid process
- Radial tuberosity

**Ulna**

- Coronoid process
- Olecranon
- Semilunar notch
- Styloid process
- Radial notch

**Carpals**

- Cuneiform
- Trapezium
- Lunar
- Magnum
- Trapezoid
- Central
- Pisiform
- Unciform
- Radial sesamoid
- Scapholunar
- Scaphoid

**Metacarpal**

- Plantar tubercle

**Sesamoids**

- Proximal sesamoid
- Distal sesamoid

**Phalanges**

- $1^{st}$, $2^{nd}$, $3^{rd}$, $4^{th}$, $5^{th}$
- Carpal
- Tarsal

**Inominate**

- Acetabulum
- Iliac crest
- Ilium

- Ischial tuberosity
- Ischium
- Pubic symphysis
- Pubis

**Fabella**

- Lateral
- Medial

**Femur**

- Greater trochanter
- Head
- Lateral condyle
- Lateral epicondyle
- Lesser trochanter
- Medial condyle
- Medial epicondyle
- Neck
- Patellar track
- Third trochanter

**Patella**

**Tibia**

- Lateral condyle
- Medial condyle
- Medial malleolus
- Tibial tuberosity

**Fibula**

- Head
- Lateral malleolus
- Distal fibula (herbivore)

**Tarsals**

- Astragalus
- Calcaneum
- Cuboid
- Ectocuneiform
- Entocuneiform
- Mesocuneiform
- Navicular
- Sustentaculum
- Naviculocuboid

- Mesoectocuneiform

**Metatarsal**

- Plantar tubercle

**Non-articulating bones**

- Baculum (male)
- Dermal ossicle (sloth)
- Sclerotic ossicles (birds and lizards)
- Falciform (sloth)
- Tracheal ring (birds)
- Dermal scale (lizard)

**Variations for juveniles**

- Diaphysis – shaft of juvenile long bone
- Epiphysis – the unfused articular surfaces of juvenile bone

**Numbers**

- Ribs – roman numerals
- Metapodials – roman numerals
- Digits – roman numerals
- Phalanges – Arabic numerals—1$^{st}$, 2$^{nd}$, 3$^{rd}$, 4$^{th}$, 5$^{th}$, terminal

## Curation

In order to curate specimens into the collections of the George C. Page Museum, all of the above-mentioned steps for excavation, preparation, and identification must be followed. The field number, orientation measurements, and pertinent field notes and photographs are all integral parts of the specimen information and must be readily available. Each specimen will receive an individual catalog number that is first recorded in an archival catalog book and then entered into the electronic database EMu, which is stored on the Natural History Museum's server. Once cataloged, each specimen is stored taxonomically in the collections. Specimens are housed in metal or wooden drawers within standard metal Lane cabinets. On average each drawer holds about seventy five specimens and each cabinet contains nine drawers.

Based on a typical deposit for Project 23, a 1m X 1m x 25cm grid yields approximately 1000 macro-vertebrate specimens per one (1) cubic meter. Additionally each cubic meter can have up to 2000 micro-vertebrate fossils. A typical conical shaped deposit can be up to 30 cubic meters.

## Appendix A

Table 1. Anatomical codes used for orienting specimens in the 2- and 3-point measurement system.

| | |
|---|---|
| A -- Anterior | Px -- Proximal |
| P -- Posterior | Dt -- Distal |
| M -- Medial | Lt -- Left |
| L -- Lateral | Rt -- Right |
| D -- Dorsal | R -- Root |
| V -- Ventral | C -- Crown |

Table 2. Anatomical codes of osteologic points used for orienting specimens in the 3-point measurement system.

## MAMMALS

Skull:
- AP - Anterior Premaxillae
- OC - Occipital Condyles
- POP- Postorbital Process (Rt or Lt)

Mandible:
- A - Anterior
- CP - Coronoid Process
- P - Posterior

Vertebra:
- AC - Anterior Centrum
- ANS- Anterior Neural Spine
- NS - Neural Spine
- PC - Posterior Centrum
- TP - Transverse Process (Rt and Lt)

Rib:
- Dt - Distal
- GC - Greatest Curve
- Px - Proximal
- Tub- Tuberculum

Scapula:
- AP - Acromion Process
- CP - Coracoid Process
- D - Dorsal
- PA - Posterior Angle
- V - Ventral

Humerus:
- Dt - Distal
- LEP- Lateral Epicondyle
- MEP- Medial Epicondyle
- Px - Proximal

Radius:
- Dt - Distal
- Px - Proximal
- RT - Radial Tuberosity

Ulna:
- CP - Coronoid Process
- Dt - Distal
- Px - Proximal

Innominate:
- IC - Iliac Crest
- IS - Ischial Tuberosity
- PU - Anterior Pubic Symphysis

Femur:
- Dt - Distal
- FC - Fovea Capitis
- Px - Proximal

Tibia:
- Dt - Distal
- Px - Proximal
- TT - Tibial Tuberosity

Fibula:
- Dt - Distal
- LM - Lateral Malleolus
- Px - Proximal

Calcaneus:
- Dt - Distal
- Px - Proximal
- S - Sustentaculum

Metapodial:
- Dt - Distal
- PT - Plantar Tubercle
- Px - Proximal

## BIRDS

Skull:
- Same as Mammals

Mandible:
- Same as Mammals

Vertebra:
- NS - Neural Spine
- TP - Transverse Process (Rt and Lt)

Sternum:
- A - Anterior
- CA - Carinal Apex
- P - Posterior

WESTSIDE SUBWAY EXTENSION

Project No. PS-4350-2000

**Attachment 3**

# Wilshire / Fairfax Station Construction Methodology

Task No. 7.04.__

*Prepared for:*

Metro

*Prepared by:*

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| Review Copy | | |
|---|---|---|
| | Date | Initials |
| Originator | 28-Jul-11 | LBC |
| Checker | | |
| Back checker | | |
| Verified by | | |

July 28, 2011

# 1.0 BACKGROUND

The Wilshire/Fairfax station box excavation will be approximately 860-ft long, 70-ft wide, and 60 to 70-ft below street level. The station extends beneath the intersection of Wilshire Boulevard and Fairfax Avenue - see Figure 1-1. The station entrance is planned to be located near the northwest corner of Wilshire and Fairfax between the 99 Cent Only Store and Johnie's Coffee Shop. Two alternative entrances under consideration; the south side of Wilshire between South Orange Grove Avenue and South Ogden Drive and; within the LACMA building at the north east corner of Fairfax Avenue and Wilshire Boulevard (May Company). A construction staging and materials laydown area is planned for the south side of Wilshire between South Orange Grove Avenue and South Ogden drive. Side access shafts will be located at the construction staging and materials laydown area and at the location selected for the station portal. The side access shafts will be excavated to the full depth of the station. The station box will be excavated by the cut and cover method and most probably use a temporary shoring system to support the excavation and decking system during construction, though a permanent shoring system that would be integrated into the permanent station structure could also be used. The side access shafts will be excavated by the open cut method and would most probably use the same type of shoring system that is used on the station box.

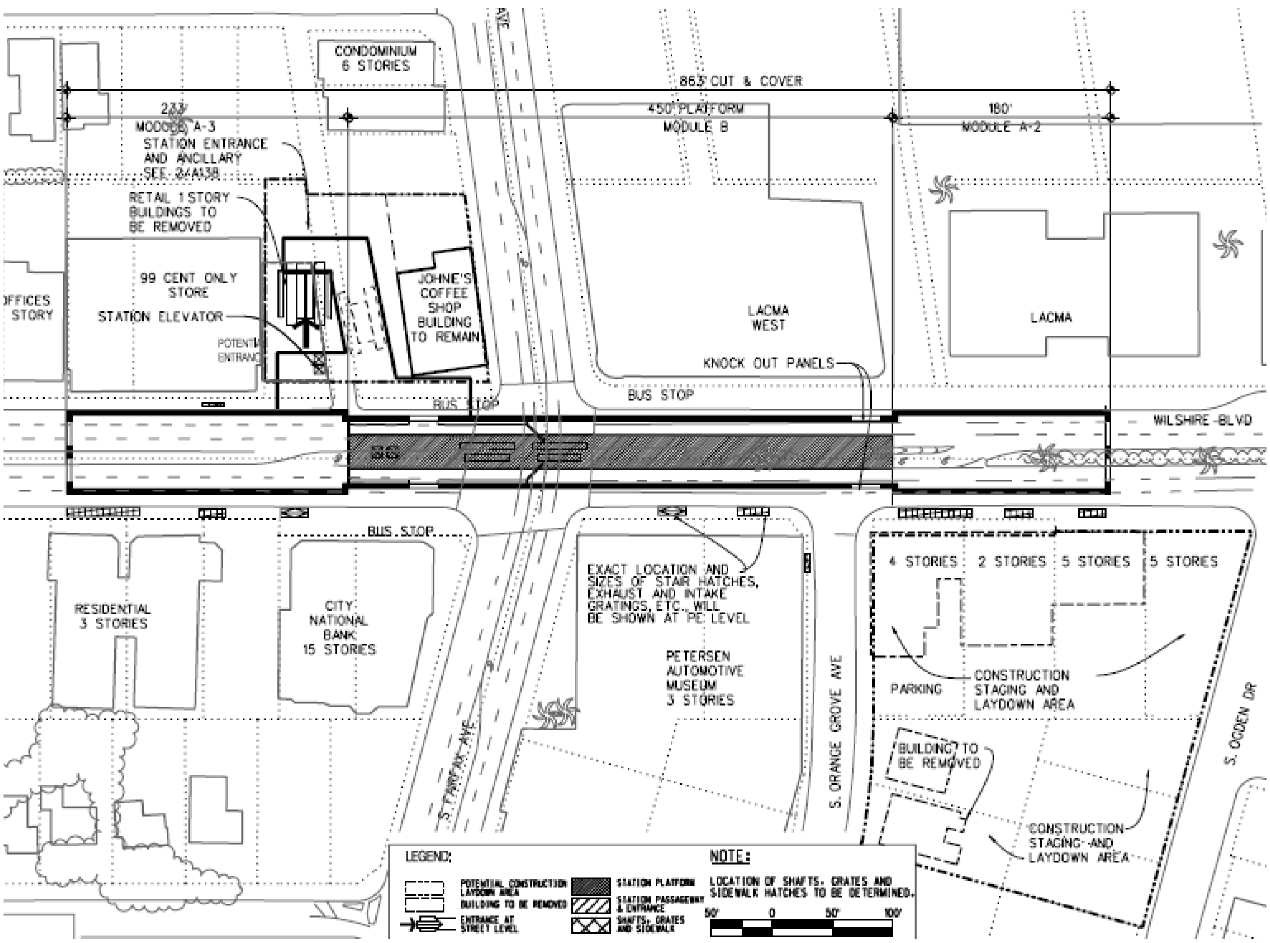



**Figure 1-1: Wilshire/Fairfax Station Box**

# 2.0 GEOLOGIC CONDITIONS

The geologic conditions in this region consist of soft alluvium deposits of sands, silty sand, clayey sand, gravely sand, silty clay, clayey silt, shell fragments, soil saturated with crude oil, and asphaltic (tar) sands. Several borings were taken within the station area; see Figures 2-1 through 2-4. Core G-118 (Figure 2-1) was taken east of the station box between La Brea and Fairfax, the sample at 82-ft below ground surface (bgs) consists of silty clay/clayey silt with traces of crude oil. The portion of ring sample G-123 shown in Figure 2-2 is located just east of Fairfax at 60-ft bgs and consists of predominantly fine grained soil with channels of medium grained sand saturated with crude oil. Heavy tar was reported in G-123 from 38 – 110-ft bgs. Core sample G-124 (Figures 2-3 and 2-4) was obtained just west of Fairfax by the Standard Penetration Test (SPT). The sample pictured was taken from 80-ft bgs and consists of medium to coarse grained sand saturated with tar. Heavy tar was reported in G-124 from 45 – 105-ft bgs. The consistency of tar in this region ranges from dry and hard to wet and oozing. This reach is also known to contain pockets of pressurized gases and dissolved gases in groundwater. The groundwater conditions are measured to have a water table depth of 74-ft bgs, and zones of perched water between 10 – 50-ft bgs. Since the station box invert depth will be located between 60 – 70-ft bgs, perched water can be anticipated during excavation.

Figure 2-1 Core Sample G-118

Figure 2-2 Core Sample G-123

Figure 2-3 Core

Figure 2-4

Sample G-124 (1 of 2)

Core Sample G-124 (2 of 2)

## 2.1 Gassy Ground Conditions

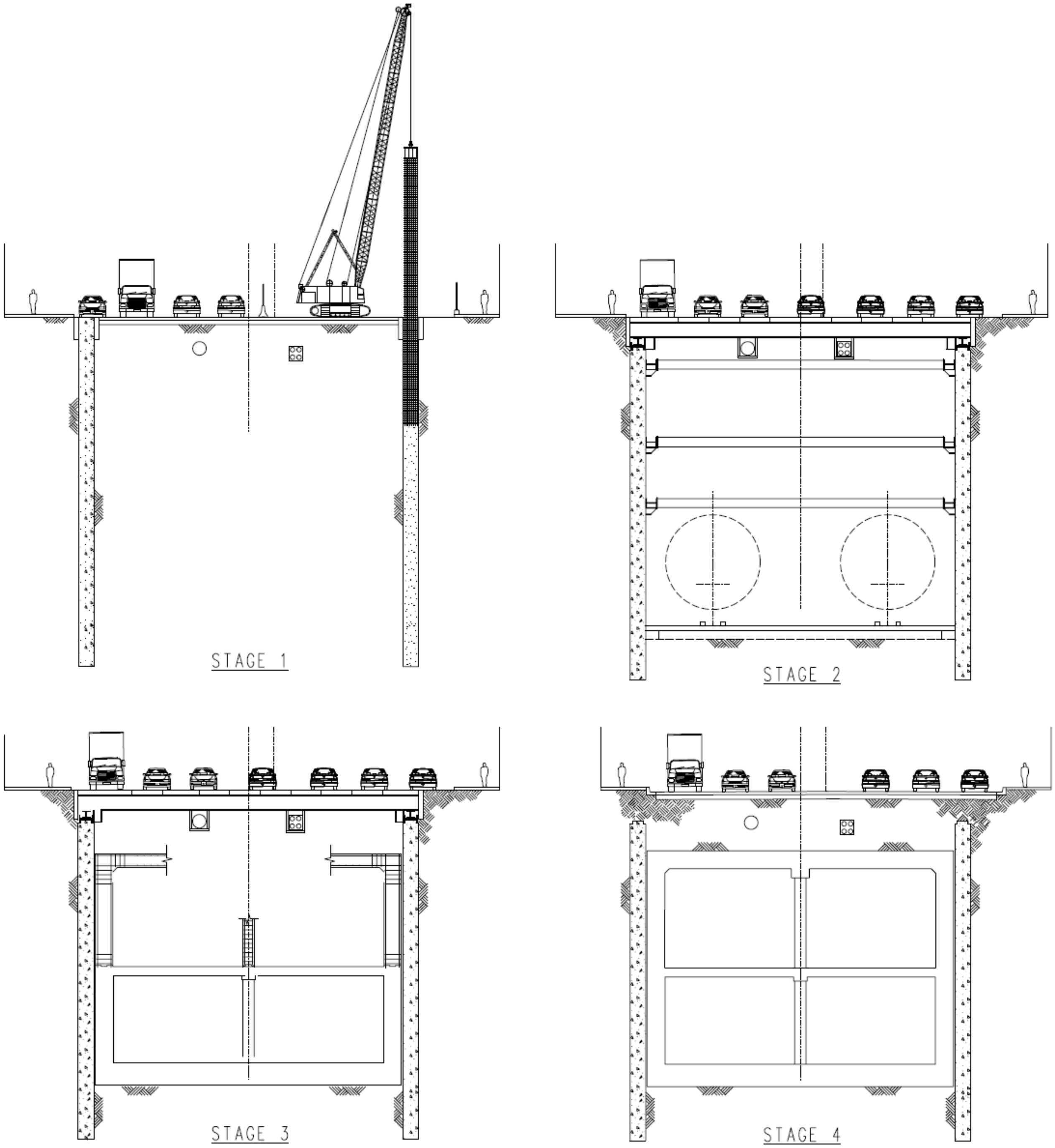
The gases present in the soils of this region are methane ($CH_4$) and hydrogen sulfide ($H_2S$). They are likely to occur in pressurized pockets as well as in a dissolved state in groundwater. These gases can seep into tunnels and other excavations through soil and also through discontinuities (fractures, faults, etc.) in bedrock. $CH_4$ and $H_2S$ are considered hazardous gases due to their explosive properties. $H_2S$ is also highly toxic. Being heavier than air, it tends to accumulate at the bottom of poorly ventilated spaces. Although very pungent at first, it quickly deadens the sense of smell, so potential victims may be unaware of its presence. $CH_4$ is extremely flammable and may form explosive mixtures with air. It is odorless and lighter than air, and it dissipates quickly once at the surface causing no threat of explosion. However, in 1985 an explosion occurred at the Ross Dress-for-Less in the Fairfax area which resulted in injuries requiring hospital treatment of twenty-three people. The explosion took place in a poorly ventilated ancillary room of the building where $CH_4$ gas had accumulated. There was no gas detection equipment at this location.

# 3.0 EXCAVATION SUPPORT TECHNIQUES

Cut and cover excavation is the preferred technique to excavate the station box structure, although cut and cover still leads to lengthy occupation of streets with noise disturbances and interrupted access. Traffic interruptions can be mitigated by performing most excavation below a temporary decking system constructed at an early stage.

**Figure 3-1: Roadway Operations Restored on Temporary Decking System**

Figure 3-2: Open Cut Excavation




Shoring the excavation walls and providing structural support beneath the decking system can be accomplished through a variety of excavation support techniques. The following sections describe several excavation support methods, including: soldier pile and lagging, slurry walls, tangent piles, secant piles, and deep soil mix walls.

Figure 3-3 Initial Excavation at Soto Station


Figure 3-4 Precast Concrete Decking


**Figure 3-5: Installation of Decking (1 of 2)**

**Figure 3-6: Installation of Decking (2 of 2)**

## 3.1 Soldier Piles and Lagging

Soldier pile and lagging walls are a type of shoring system typically constructed along the perimeter of excavation areas to hold back the soil around the excavation. This support system consists of installing soldier piles (vertical structural steel members) at regular intervals and placing lagging in between the piles to form the retaining structure. Pre-augering is necessary for installation of the soldier piles. Pre-augering involves drilling holes for each pile from the street surface to eliminate the need for pile driving equipment and thereby reduces project noise and vibration levels that would otherwise occur while pile driving. Pre-augering also provides better accuracy of location than pile driving. The lagging, which spans and retains the soil between the piles, is typically timber or shotcrete (sprayed-on concrete) and is installed in a continuous downward operation taking place concurrently with excavation. The installation of soldier piles and lagging is a relatively clean process. The majority of construction materials, such as, drilled earth spoils, concrete, backfill, and H-piles are easy to contain within the construction site. The soldier piles and deck beams are installed first with excavation and lagging installation taking place from beneath the street decking.  A soldier piles and lagging earth retention system is shown in Figures 3-7 through 3-9. The equipment required for installation of the soldier piles includes drill rigs, concrete trucks, cranes, and dump trucks.

Soldier piles and lagging are generally used where groundwater inflow is not a consideration, or where grouting, or lowering of the groundwater level (dewatering) can be used to mitigate water leakage between piles. Based on findings from core samples, the geologic conditions in this area consist of soils containing deposits of oil and tar. Where these deposits occur along the excavation perimeter, oil or tar may tend to seep between the joints in the lagging. This is not considered to be a hazard to workers, although some cleanup may be necessary.

Alternatives to soldier pile and lagging walls being considered for this station include tangent pile or secant pile walls, slurry walls, and deep soil mix walls (see next sections below).


**Figure 3-7: Pre-augering for Soldier Pile**

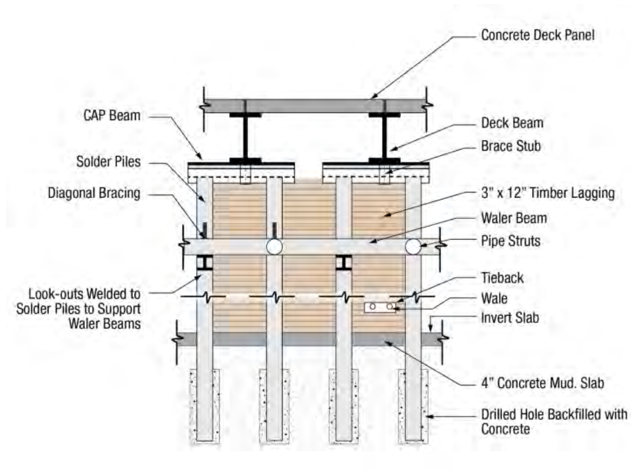



**Figure 3-8: Cut and Cover with Soldier Pile and Lagging**

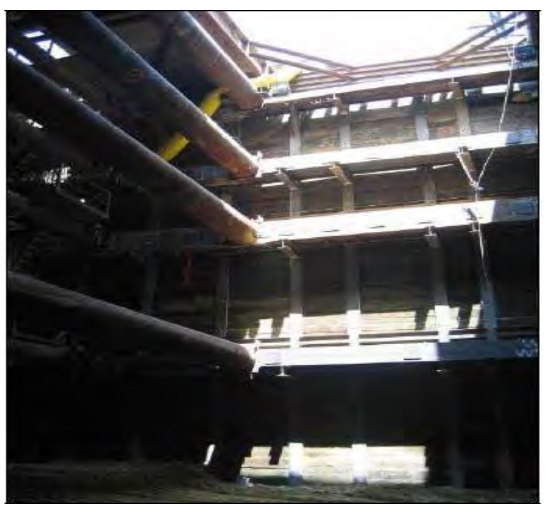


**Figure 3-9: Soldier Pile and Lagging**

## 3.2 Tangent Pile or Secant Pile Walls

Tangent pile walls consist of contiguous cast-in-drilled-hole (CIDH) reinforced concrete piles – see figure 3-10. The contiguous wall generally provides a better groundwater seal than the soldier pile and lagging system, but some grouting or dewatering could still be needed to control leakage between piles.

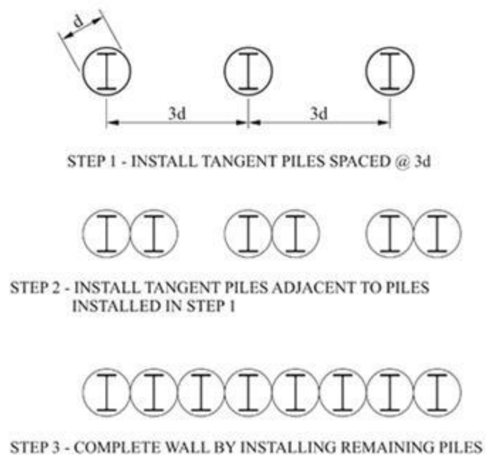



**Figure 3-10: Tangent Pile Installation**

A secant pile wall system is similar to the tangent pile wall but the piles have some overlap, facilitating better water tightness and rigidity - see figure 3-11. This method consists of boring and concreting the primary piles at centers slightly less than twice the pile diameter. Secondary piles are then bored in between the primary piles, prior to the concrete achieving much of its strength.

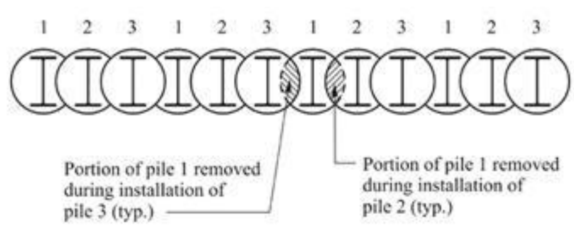



**Figure 3-11: Secant Pile Installation**

In terms of relative cleanliness, tangent pile and secant pile walls are comparable to one another and both are more difficult to contain than soldier piles and lagging due to the greater amount of pumped concrete and the expected larger diameter of drilled holes. The completed secant pile wall for the Barnsdall Shaft in Hollywood for the Metro Red Line project is shown on Figure 3-12. Secant and Tangent pile shoring systems are slower to construct that soldier pile and lagging and therefore have the disadvantage of requiring longer lane closures on Wilshire while they are being constructed. Furthermore, because of the close spacing of tangent piles, utilities crossing the wall often require relocation whereas a soldier pile system can often be built around the existing utilities. The equipment required for installation of the tangent pile or secant pile walls includes drill rigs, concrete trucks, cranes, and dump trucks.

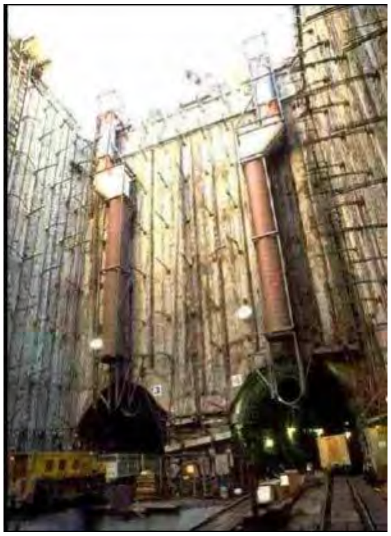


**Figure 3-12: Secant Pile Wall at Barnsdall Shaft on Metro Red Line**

## 3.3 Diaphragm/Slurry Walls

Diaphragm walls (commonly known as slurry walls) are structural elements used for retention systems and permanent foundation walls. Use of slurry wall construction can provide a nearly watertight excavation, eliminating the need to dewater. Slurry walls are constructed using deep trenches or panels which are kept open by filling them with a thick bentonite slurry mixture. After the slurry filled trench is excavated to the required depth, structural elements (typically a steel reinforcement cage - see Figure 3-15) are lowered into the trench and concrete is pumped from the bottom of the trench, displacing the slurry. Figure 3-13 and Figure 3-14 illustrate slurry wall excavation equipment.

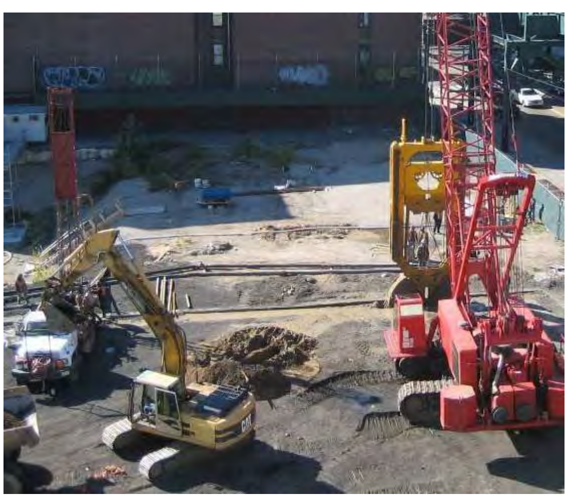


**Figure 3-13: Slurry Wall Construction Equipment**

**Figure 3-14: Clamshell Digger for Slurry Wall Construction**

Tremie concrete is placed in one continuous operation through one or more pipes that extend to the bottom of the trench. The concrete placement pipes are extracted as the concrete fills the trench. Once all the concrete is placed and cured, the result is a structural concrete panel. Grout pipes can be placed within slurry wall panels to be used later in the event that leakage through wall sections, particularly at panel joints, is observed. The slurry that is displaced by the concrete is saved and reused for subsequent panel excavations.

**Figure 3-15: Steel Reinforcement Cage for Slurry Wall**

Slurry wall construction advances in discontinuous sections such that no two adjacent panels are constructed simultaneously. Stop-end steel members are placed vertically at each end of the primary panel to form joints and guides for adjacent secondary panels. In some cases, these members are withdrawn as the concrete sets. Secondary panels are constructed between the primary panels to create a continuous wall. Panels are usually to full depth and 8 – 20-ft long and vary from 2 – 5-ft wide.

Similar to other shoring systems, slurry wall construction would occur in stages, working on one side of the street at a time. These walls have been constructed in virtually all soil types to provide a watertight support system in addition to greater wall stiffness to control ground movement. Because slurry walls are thicker and more rigid than many other shoring methods, the walls may in some cases be used as the permanent structural wall, although this application is not anticipated for this project. Where slurry walls are used, the thickness of the permanent structural walls can sometimes be reduced, i.e. when compared to wall thicknesses used with a conventional soldier pile and lagging system after removal of internal bracing.

Slurry wall construction materials are the most difficult to contain within the construction site of all the shoring types being considered due to the inherent messy nature of bentonite slurry combined with the operational characteristics of the clamshell digger which will likely be used to excavate large volumes of soil from the wall trench. Slurry walls are generally not adaptable to utility crossings and all utilities crossed by the wall would require temporary or permanent relocation. The equipment required for installation of the slurry walls includes clamshell or rotary head excavators, concrete trucks, slurry mixing equipment, cranes, slurry treatment plant, and dump trucks. The bentonite slurry would require disposal after a number of re-use cycles. Slurry walls are also slow to construct and will be very disruptive to traffic on Wilshire Boulevard.

## 3.4 Deep Soil Mix Walls

Deep soil mix walls are another type of temporary or permanent shoring system for deep excavation. Mechanical soil mixing is performed using single or multiple shafts of augers and mixing paddles. See Figure 3-16. The auger is rotated into the ground and slurry is pumped through the hollow shaft feeding out at the tip of the auger as the auger advances. Mixing paddles blend the slurry and soil along the shaft above the auger to form a soilcrete mixture with high shear strength, low compressibility, and low permeability. Spoils come to the surface comprised of cement slurry and soil with similar consistency to what remains in the ground. Steel beams are typically inserted in the fresh mix to provide structural reinforcement. A continuous soil mix wall is constructed by overlapping adjacent soil mix elements. Similar to secant pile walls, soil mix elements are constructed in alternating sequence; primary elements are formed first and secondary elements follow once the first have gained sufficient strength.

Deep soil mix wall construction materials are also difficult to contain. Most of the construction process is performed by a single piece of equipment which mixes cement and soil in situ. Cement and soil mixture can be expected to escape beyond the confines of the drilling operation creating problems for traffic and pedestrians. The equipment required for installation of deep soil mix walls includes multi-shaft drill rigs, concrete trucks, cranes, and dump trucks.

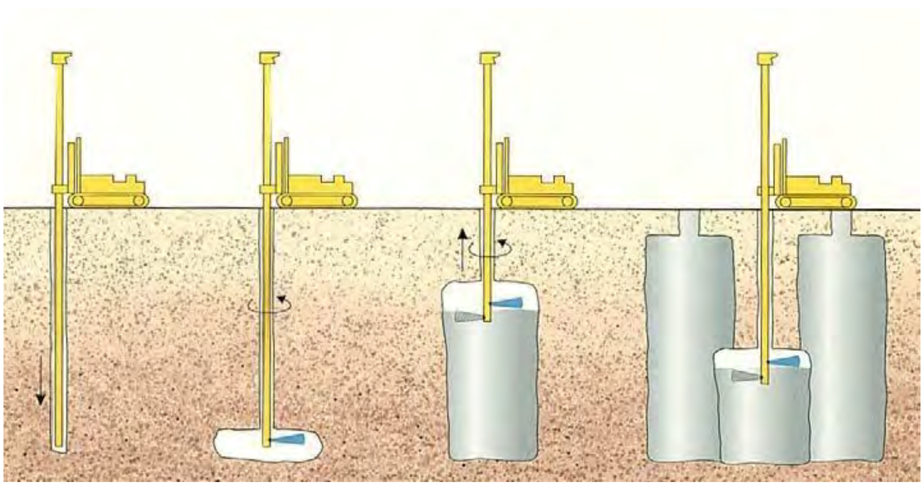


**Figure 3-16: Deep Soil Mix Construction**

## 3.5 Comparison of Excavation Support Techniques

Due to the speed of construction, and the ability to work around utilities, soldier piles and lagging is preferred unless site conditions dictate the use of other methods. Soldier piles and lagging is the predominant shoring system used in the Los Angeles area and has been used successfully by Metro on construction of both Red and Gold Line stations. Experience at the LACMA parking garage excavation suggests that soil off-gasses immediately after being exposed but with a short period of time, the off gassing slows to levels acceptable for work. This suggest that the relatively impervious seal achieved by slurry walls, secant piles, and deep soil mix walls may only provide very short term benefits and that gas entering the station box excavation through a soldier pile and lagging system could be controlled with a well designed ventilation system.

Since it is anticipated that gassy soils will be encountered regardless of shoring system type, various methods of providing a safe and hazard free workplace will be implemented in all situations. No matter which type of temporary shoring system is selected; other measures such as, partially open decking, ventilation, gas detection, and Personal Protective Equipment (PPE), will be in use to protect workers from gases that may enter the excavation site.

**Table 3-1: Comparison of Excavation Support Types**

| Shoring Method | Permeability | Installation Duration | Containment Impacts | Noise / Vibration Impacts | Traffic Impacts | Utility Impacts | Business Impacts |
|---|---|---|---|---|---|---|---|
| Soldier Pile & Lagging | High | concurrent w. excavation | Low | Moderate | Moderate | Moderate | Moderate |
| Slurry Wall | Low | 3 Months | High | Moderate | High | High | High |
| Secant Pile | Low | 3 Months | Moderate | Moderate | High | High | High |
| Tangent Pile | Moderate | 3 Months | Moderate | Moderate | High | High | High |
| Deep Soil Mix | Low | 3 Months | Moderate | Moderate | High | High | High |

## 3.6 Construction Staging

For all types of shoring, the contractor would first occupy one side of the street to install one line of excavation support piles or wall panels. The installation will require extended closures of 2 – 3 traffic lanes on the side of the street where the equipment would be staged. After installation of piles or walls on both sides of the street at the station excavations, piles or walls would then be installed across the street at the station ends. This operation would also require lane closures, and is often done during night-time or weekend periods. The contractor would then proceed with installation of deck beams, installation of the deck panels and excavation and bracing. Deck panels (decking) allow continued traffic and pedestrian circulation since they will typically be installed flush with the existing street or sidewalk levels, though raised decking, which requires less excavation during installation is being discussed with the traffic authority. Raised decking does have particular advantages at Wilshire / Fairfax Station as less excavation during the weekend closures while installing the decking makes it less likely that fossils will be encountered during the decking operation.

Deck installation will require successive full road closures on weekends with traffic detours. The decking would be installed in stages, commensurate with the amount of decking that can be installed during a weekend closure. Typical decking installation rates range from 50 -100 ft / weekend for an installation crew. Multiple crews will be used wherever possible to reduce the number of full road closures

## 3.7 General Approach to Handling Utilities

Prior to beginning construction of shoring and decking, it will be necessary to relocate, modify or protect in place all utilities and underground structures that would conflict with excavations. The contractor will verify locations through potholing methods and where feasible, the utility will be relocated so as to stay out of station or other surface structure excavation. Where the utility cannot be relocated outside the excavation footprint, it will be exposed and hung from the supporting structure (deck beams) for the roadway decking over the cut-and-cover structure. See figures 3-17 and 3-18.

**Figure 3-17: Utilities Hung from Deck Beams**

**Figure 3-18: Utilities Hung from Deck Beams (Close Up)**

Shallow utilities, such as maintenance holes or pull boxes, which would interfere with excavation work, will require relocation. The utilities alignments will be modified and moved away from the proposed facilities. Utility relocation takes place ahead of station and other underground structure excavation. During this time, it will be necessary to close traffic lanes.

It is possible that in some instances, block-long sections of streets would be closed temporarily for utility relocation and related construction operations. Pedestrian access (sidewalks) would remain open and vehicular traffic would be re-routed. Temporary night sidewalk closures may be necessary in some locations for the delivery of oversized materials. Special facilities, such as handrails, fences, and walkways will be provided for the safety of pedestrians.

Minor cross streets and alleyways may also be temporarily closed but access to adjacent properties will be maintained. Major cross streets would require partial closure, half of the street at a time, while relocating utilities.

Utilities, such as high-pressure water mains and gas lines, which could represent a potential hazard during cut-and-cover and open-cut station construction and that are not to be permanently relocated away from the work site, would be removed from the cut-and-cover or open-cut area temporarily to prevent accidental damage to the utilities, to construction personnel and to the adjoining community. These utilities would be relocated temporarily by the contractor at the early stages of the operations and reset in essentially their original locations during the final backfilling above the constructed station. See Figure 3-19

**Figure 3-19: Backfilling Utilities in Final Location beneath Road Surface**

# 4.0 PALEONTOLOGICAL ISSUES

The Wilshire/Fairfax Station is situated within the vicinity of the Hancock Park Rancho La Brea Tar Pits. The San Pedro Sand layer exists beneath the older and younger alluvium deposits near the surface in this region. This formation has a high likelihood for producing significant paleontological resources. Because of the high likelihood of fossil discovery while excavating the Wilshire/Fairfax station box, station construction at Wilshire/Fairfax will be given the maximum time available within the overall project schedule, so that excavation can proceed slowly and carefully and fossils located and removed without schedule pressures.

Before fossil recovery can begin, utility relocation and shoring for the station excavation using one or more of the shoring methods outlined above must occur. Utility relocations, by their nature (narrow trenches beneath paved streets) will make recovery of fossils during this phase of the work unlikely. Then, any fossils that lie within the footprint of the shoring will necessarily be destroyed when the shoring is constructed, as there is no way to remove them in in advance of the shoring. However, shoring will at worst occupy less than 10% of the footprint of the station excavation, leaving 90% of the footprint unaffected and suitable for fossil recovery.

The plan for fossil removal has been based on the methods used by the Page Museum for the removal of fossils from the nearby LACMA parking garage excavation, referred to from here-on by the Page Museum name, Project 23. The ground will be excavated in shallow lifts, with museum staff on land to inspect the excavated surfaces as earth is removed and to mark the locations of fossils when discovered. It is assumed that the fossils will occur in a manner similar to that at Project 23, i.e concentrated in vertical tar "pipes" which, once located, can be boxed in place and then removed from the site for further analysis. As with Project 23, fossils can also be found away from the tar pipes so all excavated surfaces must be inspected, and the contractor's team must be altered to the possibility of finding fossils anywhere with the excavation. Again, using the Project 23 experience as a guide, fossils of most likely to be found between 10 ft bgs and 30 ft bgs, though this may not turn out to be the case at Wilshire/Fairfax.

The Project 23 site was an open excavation, not constrained by a deck at ground level. This made boxing and removal of the fossil boxes a good deal more straight forward than will be the case at Wilshire/Fairfax. Figure 4-1 shows fossils in a pit at the Page Museum, and Figure 4-2 a boxed "pipe" containing fossils being prepared at the

Project 23 site.

**Figure 4-1: Tar Deposit Containing Fossils**

**Figure 4-2: Fossil Box Construction at Project 23**

**Figure 4-3: Smilodon (Sabre Tooth Cat) Pelvic Bone Figure 4-4: Smilodon Skull in Fossil Box**

## 4.1 Minimize Excavation Done Before Decking Installation

Although the Project 23 experience suggests that fossils will mainly be 10 ft or more below street level, fossils must be anticipated anywhere within undisturbed ground. Using the cut and cover excavation technique, deck beams which support the deck panels are installed in the road bed after the piles or shoring walls are complete. The top of the deck beams sit just below the roadway surface so that the decking is flush with the roadway. The deck beams are approximately 6-ft tall and joined together with cross bracing so a minimum of 7-ft of excavation is required for their installation. On Red line and Gold Line stations, contractors have normally excavated 10 ft deep when installing the deck beams to provide clear space beneath the beams for better access when commencing to dig out from beneath the decking and to expose utilities immediately below the deck beams.

Because the street decking requires a full street closure to install, only limited times are available in which to close the street. Full street closures, especially along Wilshire Boulevard will be limited to approximately 52 hours duration on week-ends, and this will not provide time to carefully remove soil in layers to expose fossils nor to box and remove any fossils found in this initial excavation. Therefore, opportunities fossil recovery from the initial excavation for the street decking will be limited. It therefore requires a construction approach to try and reduce the depth of the initial excavation. Two strategies are being pursued in this regard. One approach is to use raised decking so that the bottoms of the deck beams can be raised up by the same height that the station decking is installed above street level. Metro is in discussions with traffic authorities regarding the acceptability of using raised decking at Fairfax. See appendix 1 for details of raised decking. The other approach is to use shallower deck beams, either for a flush deck system or in conjunction with a raised decking approach. Shallower beams will almost certainly require installing the deck beams at closer centers, probably 7 ft centers instead of the usual 14 ft centers but the shallow beams will reduce the likelihood of finding fossils during decking.

It should be noted that many utilities in the street are much deeper than the bottom of the deck beams, and any fossils would have been destroyed during the construction of such utilities. Utilities already have disturbed a significant percentage of the station excavation footprint, and this will increase with the relocations required prior to the installation of the shoring and decking. Nevertheless, there will remain areas of undisturbed soil within the 10 ft immediately below street level and fossils therefore could be found in these locations. These areas can be mapped in advance so that they can be excavated carefully.

## 4.2 Excavation of the topmost layers beneath the street decking

Once the street decking has been installed, excavation beneath the decking will commence. The side access shaft(s) from the contractor's laydown area and from the station portal site will be excavated in shallow lifts, using methods similar to those of Project 23. Any fossils found will be removed. Once the side access shafts are deep enough to allow equipment to commence digging beneath the street decking, equipment will be lowered into then shaft to commence digging. One scenario will be for the contractor to dig the initial lift by scraping down the face, using low headroom equipment such as a Gradall or other equipment acceptable to Metro and to the Page Museum. The working face would be inclined at probably a 2:1 slope and would be accessible for inspection. The excavation would proceed in this manner until the first lift was completely removed. The height of the first lift will be determined by the head room needed by the equipment needed for the subsequent lifts, but probably of the order of 12-14 ft. depending on the equipment selected, subsequent lifts could continue to be inclined or horizontal. Fossils and tar pipes containing fossils would be removed under the supervision of Page Museum staff, probably using the boxing techniques developed for Project 23. Because the Fairfax Station will be decked, handling large boxes beneath the decking will be very difficult. Boxes of not more than 500 cubic ft (approximately 30 tons) are proposed as an upper limit, and smaller boxes for the first lift below the decking may be necessary so that low headroom equipment will be able to carry the boxes back to the side access shaft. Actual box sizes can be determined in the field by the contractor and paleontologists. Figures 4-5 and 4-6 show the proposed excavation sequence.

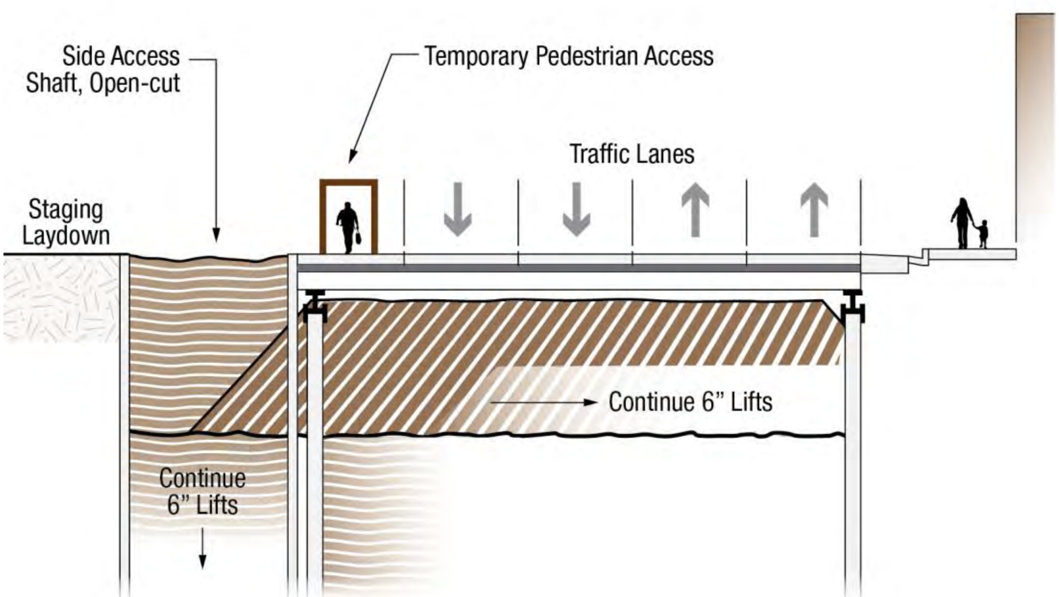



**Figure 4-5: Cross Section Showing Excavation Procedure of Shallow Lifts at 2:1 Slope Beginning from the Side Access Shaft**

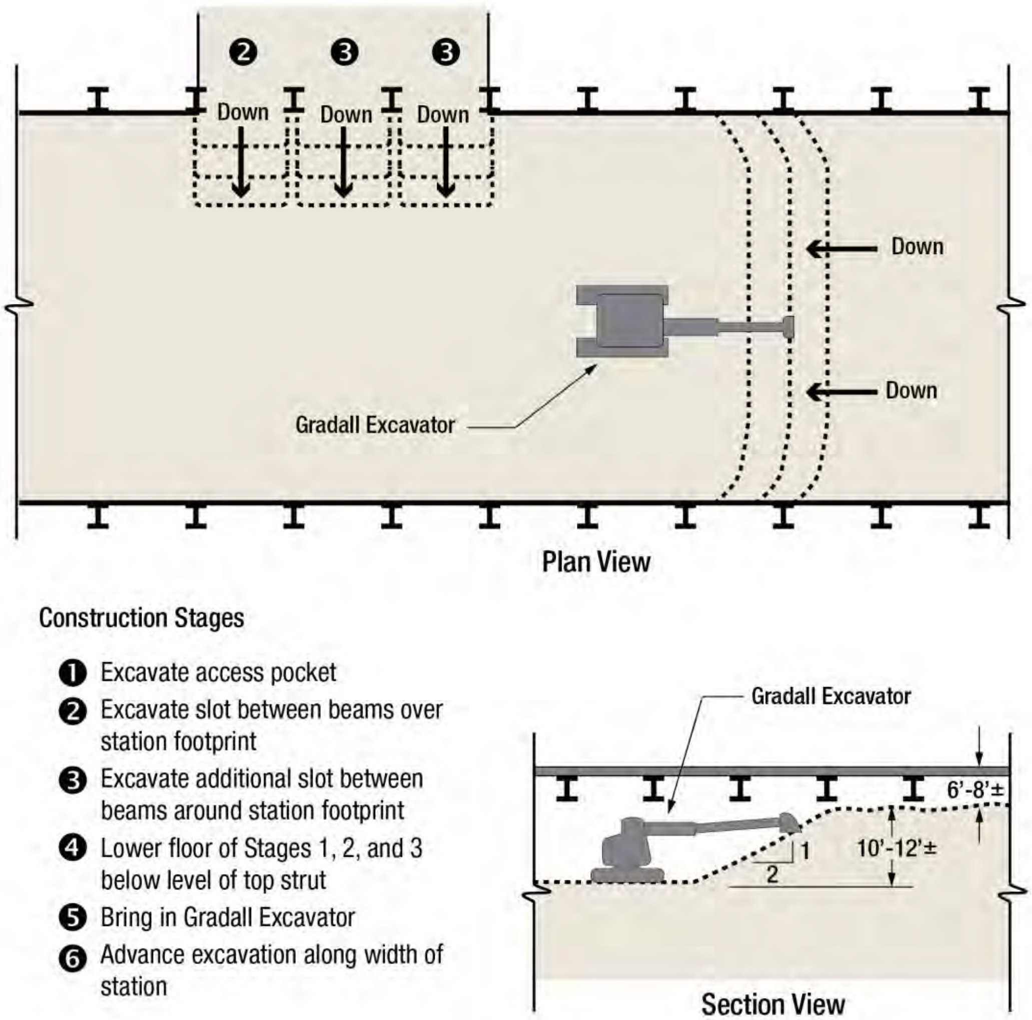



**Figure 4-6: Plan Showing Excavation Procedure of Shallow Lifts with Low-Profile Gradall Excavator**

**Figure 4-7: Open Cut Excavation of Side Access Shaft**

**Figure 4-8: Tracked Loader Removing Muck from Beneath Struts**

**Figure 4-9: Compact Track Loader**

**Figure 4-10: Compact Excavator – 6.75′-Tall/12′-Long/6.5′-Wide**

## 4.3 Excavate in Layers

The station box and side access shafts will be excavated in shallow lifts to carefully expose and locate fossils. The Page Museum is suggesting 6" lifts based on experience at the Los Angeles County Museum of Art (LACMA) parking garage. From previous experience with fossil recovery from tar-laden soils in this region, fossils generally, though not always, reside in tar deposits only. Other soil types should be generally free of fossils and can be removed with less concern for damage to fossils, though non-tarry areas will also require continuous surveillance.

Compact track loaders and compact excavators are likely necessary for initial soil removal directly beneath the deck beams due to their low vertical clearance, and relatively small bucket size capable of excavating precise lifts. Continuous tracks improve vehicle traction on soft and sticky terrain and reduce the amount of pressure exerted on the soil below. A pressurized cab would increase protection from gas intrusion although this may not be an option due to tight clearances and proper ventilation will still be needed regardless. If soil conditions permit, a rubber tire vehicle like skid steer loaders or equipment fitted with floatation tires may be used instead of compact track loaders. Gradalls operate a bucket at the end of a telescopic arm in a linear motion. The linear shoveling motion enhances depth control improving the ability to cut in precise shallow lifts. These should be considered as well. Track loaders, wheeled dozers and hydraulic excavators should be employed to remove the bulk of the soils in order to maintain efficiency in excavating. Excavation with these tools will require careful observation to identify the location of tar deposits. When tar deposits are located, smaller equipment should step in to avoid damaging fossil resources with heavier machines.

**Figure 4-11: Hydraulic Excavator between Struts**

**Figure 4-12: Track Loader beneath Struts**

It is possible that the discovery and removal of fossils could lead to schedule delays and the station box structure would not be completed in time to precede the TBM breakthrough. As long as station box excavation has not breached a reasonable depth above where the top of the tunnel liner will be so that it would compromise the operation of the TBM, then the TBM drive should continue through the station box location and station excavation would work its way down and eventually break through the tunnel liner.

It may be possible to use an imaging technique to locate fossils ahead of excavating operations thus allowing the pace of excavation to accelerate beyond the recommended 6" lift limit. If the imaging technique produces a reliable indication, the boxing of fossils can be pre-planned. Some techniques of scanning for objects below the surface that should be considered are Ground Penetrating Radar (GPR), HAARP Detection using ELF and VLF radio waves, electrical resistivity imaging, and geophysical diffraction tomography.

If an Early Work Authorization is obtained, construction can begin on an exploratory shaft to test the effectiveness of the anticipated geophysical methods. The shaft could be located within the limits of a side access shaft and would ideally reach full station depth in order to learn as much as possible from this process. The length and width of the shaft should be a minimum size to allow a variety of the equipment under consideration to perform excavation operations during the exploration process. Construction methods will be tested to determine the best techniques and tools for station box excavation. Shoring types will be tested to determine the effectiveness of the planned shoring in the soils present in the area. Gas levels will be measured to gauge the specifics of the ventilation scheme.



**Figure 4-13: Skid Steer Loader** **Figure 4-14: Compact Track Loader**


**Figure 4-15: Gradall with Large Bucket**

## 4.4 Fossil Box Size

As layers of soil are removed, tar-laden sand deposits containing fossils are likely to be uncovered. When this happens, work is halted within proximity of the fossil to allow the paleontologists on site to assess the discovery and begin preparations for boxing and removal of the deposit. The technique of boxing and removing fossil deposits to an off-site facility for additional paleontological work is an efficient process that was first implemented during the construction of Project 23.

**Figure 4-16: Fossil Boxes at Project 23**

**Figure 4-17: Fossil Boxes with Worker Donning Oxygen Respirator at Project 23**

The box construction technique used on Project 23 is similar to that which is used for boxing palm trees for transport. See figure 4-16. First, the paleontologist defines the location of the fossil deposit. Next, trenches are dug around the sides and excavation continues by removing sterile soil from around the fossil zone with heavy equipment leaving an island where the deposit sits. The bottom of the box is most challenging. After the box is supported by blocks and shims at each of the four corners, workers must crawl beneath the box and dig by hand while inserting the timber boards which make up the base of the box (Figure 4-18). An alternative approach to creating the bottom of the box which would improve worker safety and expedite the excavation process would require an auger to drill holes in the island beneath the fossil deposit. Timbers would be inserted through the auger holes, thus beginning to form the base of the box. The auger would then remove the balance of soil between the timbers allowing completion of the box and freeing the deposit from the soil below. See Figure 4-19. During the excavation of Project 23, sixteen tar deposits were discovered. From the sixteen deposits, twenty-three boxes were recovered, thus giving the parking garage project its name. The boxes range in size from 5x5x5-ft (weighing 3 tons) to 12x15x10-ft (weighing 56 tons).

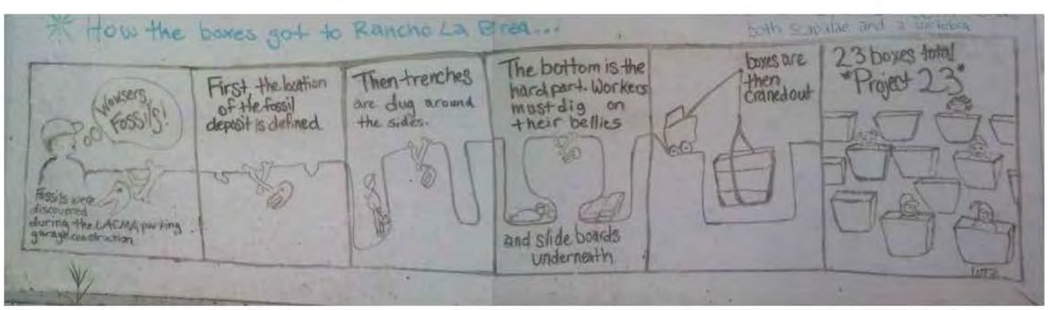



**Figure 4-18: Fossil Relocation Process. (From Page Museum Whiteboard)**

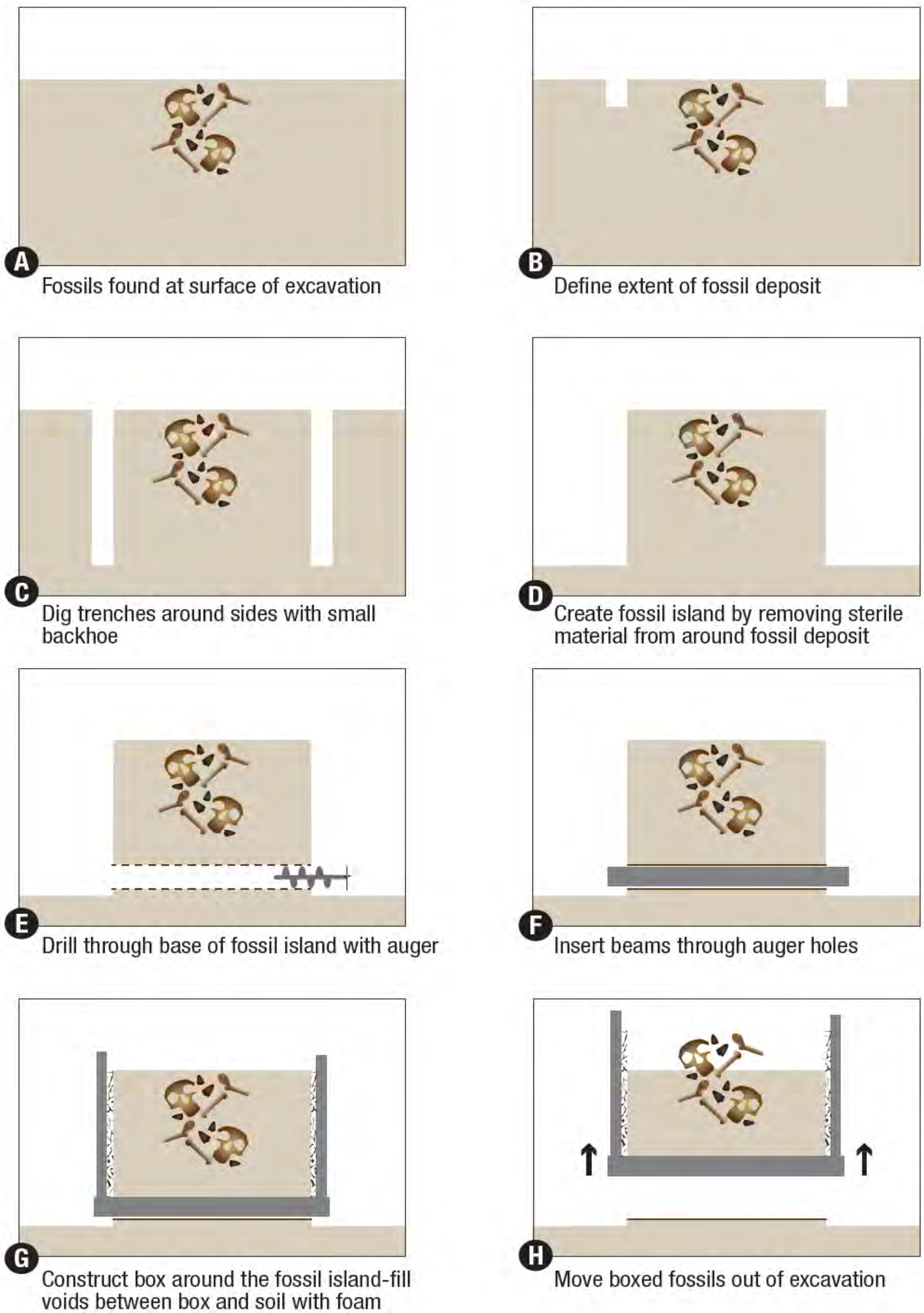



**Figure 4-19: Alternative Boxing Technique Using Auger for Floor Construction**

Depending on the size and weight of each box, fossils located beneath deck panels may be lifted in place by crane through temporary openings in the decking. However, this may prove to be impossible if street closure are not possible or the crane cannot be positioned on the street decking in a way to perform the lift. It is proposed to limit the size of fossil boxes to about 30 tons, i.e 500 cubic feet which will make boxes easier to lift or to move around below the decking with low headroom equipment or with a system of skids and temporary tracks constructed within the station box. Once positioned adjacent to the side access shaft, fossil boxes can be lifted by mobile cranes positioned on "terra firma". The crane would lift the box out through the access shaft and load it on a truck which will transport the tar and fossils either to the Page Museum site where paleontologists can continue their work or to the contractor's laydown area at South Orange Grove/ Ogden for storage and processing. Offsite processing is preferred as there is less potential for damage by heavy equipment that will be operating at the South Orange Grove/Ogden laydown area.

## 4.5 Construction Issues in Tar-Laden Soils

The asphaltic sands have unique properties and the engineering characteristics are not as well documented as compared to other soils. However, contrary to common expectations, it is proven that these sands possess shear strength. Design parameters for excavation support systems in asphaltic sands will need to consider some additional pressure due to the makeup of these soils. There are numerous cases of successful experience in construction of deep basements and underground parking structures in the Wilshire/Fairfax area soils, such as construction of underground structures at LACMA. Similar design elements, construction techniques and operating methods and procedures can be applied to the planned excavations.

**Figure 4-20: Aerial View of Project 23 Excavation with Dark Tar Seeps**

## 4.6 Potential Impacts to Construction Methods from Anticipated Tar-Laden Soils

When excavating in tar-laden soil, efforts will be undertaken to avoid excessive disturbance. Excavation methods will be closely controlled to minimize over-excavation or vibrations. When grade is achieved within these soils, a mud slab could be applied to minimize disturbance. In some cases, a layer of gravel may be placed over the asphaltic sands to increase traction and reduce the amount of soil compaction caused by construction traffic. The contractor can also apply various other materials on top of the tar such as cement, lime, or other additives to prevent it from fouling the tracked equipment. Wide tracked machinery can be used to reduce the pressure exerted on the soils below. Timber mats can make a sturdy foundation to drive equipment on. Rubber tire vehicles are considerably lighter than their tracked counterparts and could be operated with floatation tires specifically designed to minimize the amount of soil compaction caused by heavy equipment. Because the tar is rather sticky or tacky in some areas, it is anticipated that the equipment's tracks, axles, or buckets could become fouled and would require occasional cleaning. Steam cleaners would handle the task well, by heating the tar to a less viscous consistency.

## 4.7 Handling Gas Intrusions during Construction Operations

Previous projects in the Methane Risk Zone have been successfully and safely excavated. Multiple underground parking garages have been constructed in this area. For example, LACMA built a two-level subterranean parking structure in the Methane Risk Zone, previously referred to as Project 23. During the excavation, H2S (above safe working levels) was encountered on several occasions. Workers donned PPE to protect against exposure during these events. Further investigation of operating underground structures will be undertaken during future design phases to assess effectiveness of barrier systems and detection equipment used.

Since the majority of gas is expected to enter the excavation through the excavation surface, the release of gases may be constricted by applying a ground cover to all areas except the area where current excavation operations are taking place. An impervious membrane of Visqueen plastic sheeting or geotextile fabric may serve this purpose.

In areas of potential H2S exposure, there are a number of techniques that can be used to lower the risk of H2S release or exposure. Because station excavations are less confined than tunnels, gas exposure issues are anticipated to be less significant. Although pre-treatment of the ground water prior to excavation, with additives such as hydrogen peroxide or copper-zinc, is an option, it is not expected to be required. If released, H2S will not naturally dissipate because it is heavier than air, hence it would build up around the bottom of the excavation. The first line of defense is dewatering since H2S occurs in a dissolved state in ground water. Dewatering will remove any contaminated water from the excavation area. At the surface, a sealed tank would capture the water and treat the air for H2S off-gassing before discharging it to the surrounding environment. Additionally, a ventilation system will be used to introduce fresh air in the workspace. Fans will be used to circulate the air while a gas detection system monitors levels of hazardous gas. A suction system fitted with scrubbers may be required to collect H2S from the bottom of the excavation and treat the air before discharging clean air at the street surface.

CH4 is a hazard in confined spaces. As such, it is essential that workers be sufficiently protected, and thus detection and monitoring equipment would be required. Fans similar to those used to dilute H2S concentrations would also dilute CH4 concentrations in the station box. Once above-ground, CH4 dissipates rapidly in the atmosphere and would not be a health hazard.

## 4.8 Ventilation Schemes

Ventilation is required to combat harmful or dangerous gasses when present in underground construction. Cal OSHA classifies subterranean work areas as “gassy”, “potentially gassy”, “non-gassy”, or “extra hazardous”. Excavation equipment in “gassy” spaces must be manufactured to resist accidental sparks and either be sealed or of explosion proof design.

Since CH4 and H2S gases are expected to be encountered during the excavation of Wilshire/Fairfax station, adequate ventilation and continuous air quality monitoring will be in use throughout construction. In addition to maintaining acceptable levels of CH4 and H2S in the air supply, the ventilation system must maintain a certain level airflow for workers present in the work space. The size of the system is dependent on the number of persons and the size of diesel equipment underground. The air supply shall not be less than 200 CFM (cubic feet per minute) per person underground, plus 100 CFM per diesel horse brake power.

**Figure 45: Underground Ventilation Ducts**

Use of perforated deck panels, either perforated steel or concrete integrated with steel could be used in place of concrete only deck panels to allow the free flow of air between the excavation area and the surface, especially if full decking is required across the entire station box.

# 5.0 CONCLUSIONS AND RECOMMENDATIONS

The project is committed to recover fossils and to work closely with the Page Museum to minimize the loss of fossils due to the construction of a station at Wilshire/Fairfax.

The project plans to use the same recovery methods that have been proven at Project 23, and with the corporation of Page Museum staff will seek to customize and improve on these methods to tailor them for the site conditions at Wilshire / Fairfax.

Further studies are on-going to find ways to raise the height of the beams used for street decking, which in turn, will leave more soil beneath the beams for controlled excavation and fossil recovery.

The fastest and lowest cost shoring method is preferred. This means that a soldier pile and lagging system will be employed provided that continuing geotechnical investigation do not find ground conditions that preclude this system. Soldier pile and lagging shoring has the added advantage of disturbing less of the station excavation footprint than other methods, mimimizing the loss of fossils in this phase.

Gases will be controlled by installing adequate ventilation within the excavation, and by designing the street decking system with gaps for natural ventilation and elimination of pockets where gases could accumulate.

# Attachment C: Fairfax Exception Memo

cogstone
PALEONTOLOGY - ARCHAEOLOGY - HISTORY

October 21, 2013 Cogstone 2604

To: Steven Sabo, WEST Construction Manager
From: Sherri Gust, WEST Principal Paleontologist

RE: Special Exception for Cut and Cover Work at Fairfax Station

PB Engineer Amanda Elioff relayed to me the concerns of the proposers for the Design Build in regard to use of 6 inch excavation lifts for the initial 10 feet of cut due to the extremely limited time frame available to install the decking and supports (about 53 hours). I have discussed the situation with Dr. John Harris of the Page Museum this morning.

Dr. Harris and I agree that regular excavation lifts may be used for these initial 10 feet only due to the logistics of the situation. Monitors are not necessary for any work in fill but due to the use of regular excavation lifts, any work in native sediments will require use of two paleontological monitors.

The 6 inch lift requirement was only for Fairfax Station as no asphaltic matrix was observed in any geotechnical borings at Western, La Brea or La Cienega Avenues. Regular excavation lifts may be used for all work at these stations in conjunction with paleontological monitoring.

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Federal Certifications 8(a), SDB, 8(m) WOSB
State Certifications DBE, WBE, SBE, UDBE

Los Angeles County
Metropolitan Transportation Authority

March 2012

# Westside Subway Extension

*Final Environmental Impact Statement/Environmental Impact Report—Volume 4*

APPENDIX G: *Memorandum of Understanding for Paleontological Resources*


Metro®

U.S. Department of Transportation

Federal Transit Administration

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# Memorandum of Understanding

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## MEMORANDUM OF UNDERSTANDING

**THIS MEMORANDUM OF UNDERSTANDING** ("MOU") is entered into as of this 2nd day of November 2011 by and between the Los Angeles County Metropolitan Transportation Authority ("MTA") and the Los Angeles County Museum of Natural History, including the Page Museum at the La Brea Tar Pits ("Museum") (collectively, "the Parties"), for the preservation of paleontological and archaeological resources associated with the Wilshire/Fairfax Station and other portions of the Westside Subway Extension Project alignment within two miles of the Wilshire/Fairfax Station.

## BACKGROUND

**WHEREAS**, the MTA has the responsibility under Federal and State law to recover and preserve for future scientific and educational use paleontological, archaeological, and historical resources that may be impacted by the Westside Subway Extension Project and associated records; and

**WHEREAS**, the Museum has established expertise in recovery, management, curation and research of paleontological resources and is willing to permanently curate paleontological and asphalt-related archaeological resources recovered from the Westside Subway Extension Project in asphaltic deposits associated with the Wilshire/Fairfax Station and other portions of the Westside Subway Extension Project alignment within two miles of the Wilshire/Fairfax Station and recognizes the benefits which will accrue to it, the public and scientific interests by housing and maintaining the Paleontological Resources and Records Collection for study and other educational purposes; and

**WHEREAS**, the Parties hereto recognize the mutual benefits to be derived by having paleontological and archaeological resources suitably housed and maintained by Museum;

**NOW, THEREFORE**, in consideration of the terms, conditions, covenants and performances herein contained, and other consideration the receipt and sufficiency of which is hereby acknowledged, and with the intent to be legally bound hereby, the Parties agree to incorporate the above recitals into this MOU and further contract, promise and agree as follows:

1. **MTA shall:**

a. Retain a qualified principal paleontologist (minimum of graduate degree, ten years of experience as a principal paleontologist and having demonstrated expertise in vertebrate paleontology) approved by the Museum to plan, implement and supervise paleontological monitoring, preservation, fossil recovery, fossil preparation, fossil documentation and reporting of significant paleontological resources within the areas of disturbance for the Wilshire/Fairfax Station or other portions of the Westside Subway Extension Project alignment within two miles of the Wilshire/Fairfax Station. The principal paleontologist will be responsible to ensure that all subordinate personnel are appropriately qualified.

b. Require the principal paleontologist to prepare a mitigation plan, subject to approval by the MTA and Museum, to address monitoring, preservation and, recovery of any paleontological resources. The mitigation plan shall be consistent with best practices guidelines for both field and laboratory work on project paleontological resources to meet state and federal laws and guidelines and Museum standards (Attachments 1 and 2).

c. Require the principal paleontologist to monitor all ground-disturbing activities where sub-surface soils are exposed. The areas to be examined will be determined based on project plans and in consultation with construction staff and the qualified paleontologist during pre-construction meetings and as needed throughout the construction process.

d. Ensure that if subsurface paleontological resources are identified by the principal paleontologist during construction, all construction activities in the area of identified paleontological resources will be temporarily halted so that the resources may be documented and recovered. All resources shall be documented on appropriate forms approved by the Museum and these will be placed on file in the Museum.

e. Ensure that any paleontological resources, including asphaltic deposits containing fossils and/or archaeological objects, will be recovered in accordance with best practices outlined by the Museum (Attachment 1).

f. Require that the principal paleontologist have designated and secure space sufficient to store and, if necessary, analyze and process boxed or individual fossil deposits for preparation [but see section 2.c].

g. Require that the principal paleontologist record all data and, if necessary, perform excavation of boxed deposits or individual fossils, prepare fossils and store fossils prior to curation in accordance with best practices outlined by the Museum (Attachment 2).

h. Require that the principal paleontologist provide periodic progress reports including copies of all field notes to the MTA and Museum in addition to a comprehensive final report meeting all state and federal standards. The original copies of the field notes will be archived in the Page Museum at the time that the fossils are transferred to its jurisdiction.

i. Provide funding for required fossil recovery, cleaning, preservation, curation and storage and any other fossil-related Museum activities specified in Paragraph 2 based on a cost per amount recovered to be agreed upon by the MTA and Museum in a subsequent detailed Agreement to be signed between the MTA and Museum during further Project Design. Such agreement will be based in part on the Museum's cost for processing and storage of its Project 23 materials, taking into account the possible variation in the density of fossils and in the matrix in which the fossils are found. Such agreement should include contribution to cost of permanent storage premises in the event that significant quantities of fossils are recovered. Such agreement shall prevent unreasonable payment if few fossils are found, but assure payment for vital effort.

j. Allow the Museum to be involved, in an oversight capacity, for all field and laboratory work to ensure that Museum standards are being maintained.

k. Require that paleontological resources be removed expeditiously to allow Project completion according to schedule, but in compliance with Museum standards as recently demonstrated in the construction of the new LACMA Underground Garage and corresponding Project 23 Paleontological Project.

l. Retain responsibility for compliance with all legal and regulatory provisions related to monitoring, reporting, consultation, and repatriation of Native American remains and related material, including under NAGPRA and California law.

m. Assign an MTA Representative to make any further revisions or adjustments to this document necessary in the course of the project, in cooperation with the Museum.

n. Designate the Museum as the sole source for the scientific description of fossils and artifacts recovered from the Westside Subway Extension Project in asphaltic deposits associated with the Wilshire/Fairfax Station and other portions of the Westside Subway Extension Project alignment within two miles of the Wilshire/Fairfax Station. Publicity concerning the discovery of such fossils and artifacts shall be jointly undertaken by MTA and the Natural History Museum of Los Angeles County.

2. **Museum shall:**

a. Make available Museum personnel to provide oversight for the qualified principal paleontologist's preparation of a mitigation plan, subject to approval by the Agency, to address monitoring, preservation and, recovery of paleontological resources. The mitigation plan shall be consistent with best practices guidelines for both field and laboratory work on project paleontological resources to meet state and federal laws and guidelines and Museum standards (Attachments 1 and 2).

b. Make available Museum personnel to provide oversight of all field and laboratory work on paleontological resources for the duration of the project to ensure that Museum standards are being maintained.

c. Provide an option, dependent upon the volume and number of fossils recovered, that the Museum will directly house boxed fossil deposits and internally perform excavation and preparation of those deposits for compensation comparable to that offered to the principal paleontologist for similar services.

d. Provide for the professional care and management of the curated paleontological resources associated with the Wilshire/Fairfax Station and other portions of the Westside Subway Extension Project alignment within two miles of the Wilshire/Fairfax Station.

e. Ensure that personnel assigned responsibilities related to the Westside Subway Extension Project are qualified museum professionals whose expertise is appropriate to the nature and content of the paleontological resources recovered.

f. Provide and maintain a repository facility having requisite equipment, space and adequate safeguards for the physical security and controlled environment for the paleontological resources (but see 1.i).

g. Perform those conservation treatments necessary to ensure the physical stability and integrity of the paleontological resources prepared by the principal paleontologist.

h. Curate the paleontological resources to ensure adequate scientific documentation of the circumstances of their recovery.

i. Credit the MTA when the Collection or portions thereof are exhibited, photographed or otherwise reproduced and studied in accordance with the terms and conditions of Museum policy with the statement: "In Cooperation with the Federal Transit Administration and Los Angeles County Metropolitan Transportation Authority". The Museum agrees to provide the Agency with copies of any resulting publications.

3. **Paleontological Advisory Board**

The Parties agree to mutually appoint a three person Paleontological Advisory Board comprised of appropriately qualified paleontologists to help guide this effort as previously agreed by the Parties in their Paleontological MOU for this site in 1983.

4. **Amendment**

This MOU may be revised by issuance of a written amendment signed and dated by both parties.

5. **Donation of Paleontological and asphalt-related Archaeological Resources**

Agency agrees to donate title to all paleontological and asphalt-related archaeological resources to the Museum.

**IN WITNESS WHEREOF**, the Parties hereto have executed this MOU.

Jane G. Pisano 10/25/11

Dr. Jane Pisano
President and Director
Los Angeles County Museum of Natural History

Date

Arthur T. Leahy 11-02-11

Arthur T. Leahy
Chief Executive Officer
Los Angeles County Metropolitan Transportation Authority

Date

**ATTACHMENTS**

Attachment 1. Paleontological Methods for Mitigation of Fossils in the Vicinity of Hancock Park

Attachment 2. Techniques for Excavation, Preparation and Curation of Fossils from the Project 23 Salvage at Rancho La Brea

Attachment 3. Wilshire/Fairfax Station Construction Methodology

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# Attachment 1—Paleontological Methods for Mitigation of Fossils in the Vicinity of Hancock Park

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# ATTACHMENT 1

## Paleontological Methods for Mitigation of Fossils in the Vicinity of Hancock Park

# Paleontological methods for mitigation of fossils in the vicinity of Hancock Park.



Images courtesy of ArchaeoPaleo Resource Management, Inc.

2011

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# Introduction

Rancho La Brea is the world's richest Ice Age fossil locality, yielding well over 3 million fossils and representing more than 600 species of animals and plants that lived in the Los Angeles Basin between 11,000 and 50,000 years ago. The asphaltic fossil deposits generally occur in randomly distributed inverted cone-shaped masses between 10 to 35 feet in depth. The sizes of the accumulations vary considerably from less than 5 cubic feet to more than 20 cubic feet. Flat tabular deposits such as that recovered during the construction of the Page Museum are rare. Ideally, the fossil accumulations should be carefully excavated as they are discovered. The fall back position is to remove the deposit intact, preserving it for excavation at a later date. This methodology, developed during the mitigation of the LACMA underground parking structure, preserves stratigraphic integrity, permits less hurried excavation under more optimum conditions, maximizes fossil and information retrieval, and enhances opportunities for major discoveries and new scientific contributions. All data pertaining to the location and condition of newly discovered fossil deposits must be recorded and photographed as outlined later in this document.

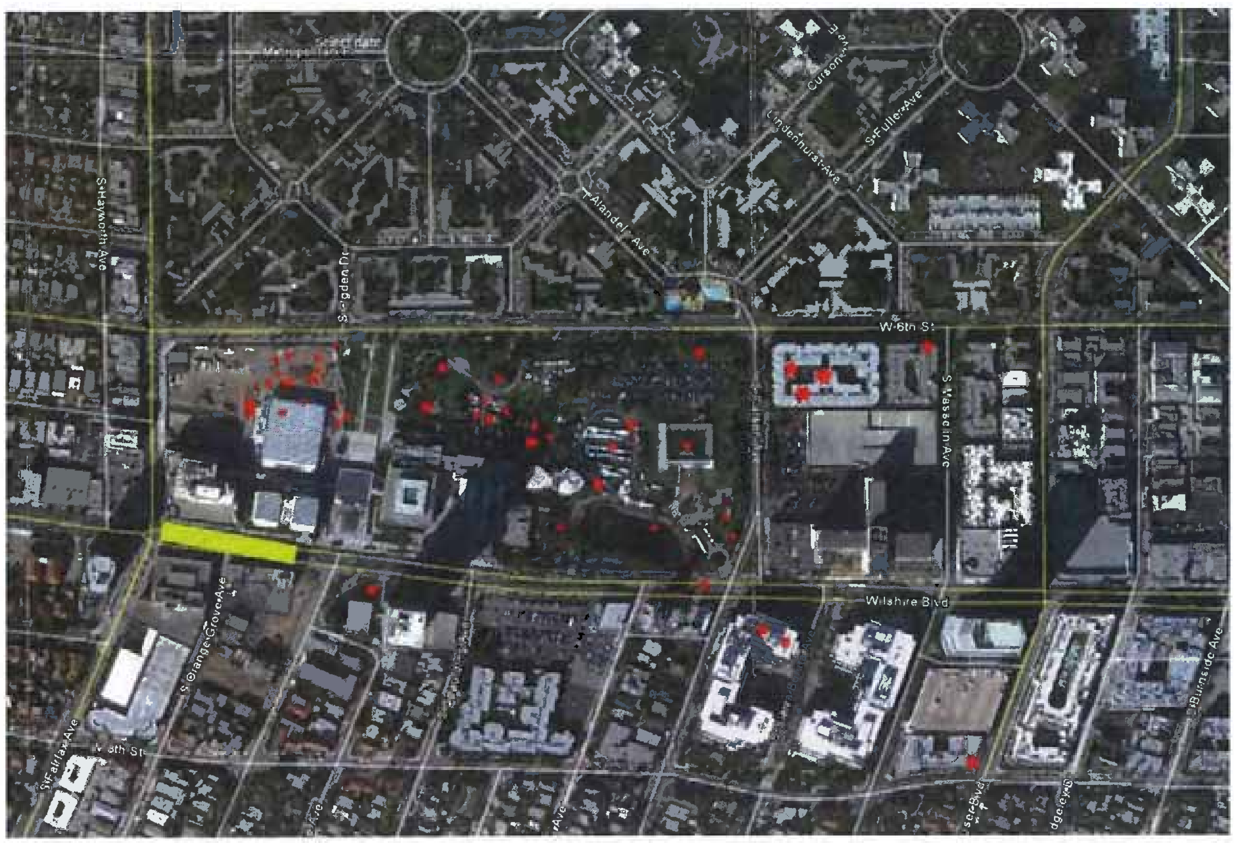



**Fig 1: Map of Hancock Park** and vicinity with known asphalt preserved fossil localities (red stars) and the approximate location of the proposed MTA subway station (yellow rectangle)

**Fig 2: Monitoring**

All excavation activity must be carefully monitored. In areas of asphaltic sediment or other areas where fossils have been discovered, sediment should be removed in 4-6" levels while paleontologists monitor closely. The monitors are empowered to halt the process as soon as fossils are located.

**Fig 3: Fossils are discovered**

After a fossil deposit has been located the surrounding area must be roped off so that paleontologists can determine the extent of the deposit or if it is an isolated fossil. In the case of an accumulation deposit this may range from 5 feet to 20 or more feet across. Construction work in the immediate vicinity of the fossil deposit must be halted temporarily but may proceed normally elsewhere in the construction site. Asphalt saturated conical shaped deposits and isolated fossil mitigation are described separately below.

## Taking Field notes

Whether an accumulation of fossils are discovered or an isolated fossil is found, detailed field notes must be taken. The precise locality of each fossil deposit must be recorded with a resource-grade GPS device, its extent clearly described, mapped, and photographed on site using conventional field data collection methods, and its context including represented lithologies and depositional environments must be described. Types of geologic information to be collected should include: the nature of bounding contacts (erosional, sharp, gradational), thickness, geometry, grain size, shape, and sorting, color (fresh and weathered, use a color chart), sedimentary structures (physical and biogenic), cement type, pedogenic features (rooting, nodules, slickensides, etc.), halos, mineral crusts, microstructures around bio-clasts, and other fossils. Types of taphonomic information to be collected should include: taxonomic

representation, skeletal articulation and association, scale and geometry of assemblage, density, and orientation of bones. Bone modification information to be collected should include: weathering, polishing, abrasion, scratch/tooth marks, root traces, borings, fragmentation/breakage, and distortion. Each isolated fossil and each individual fossil deposit must be given an individual field number. This number should be written in permanent ink on individual fossils and clearly marked in permanent marker or paint on the box containing a deposit.

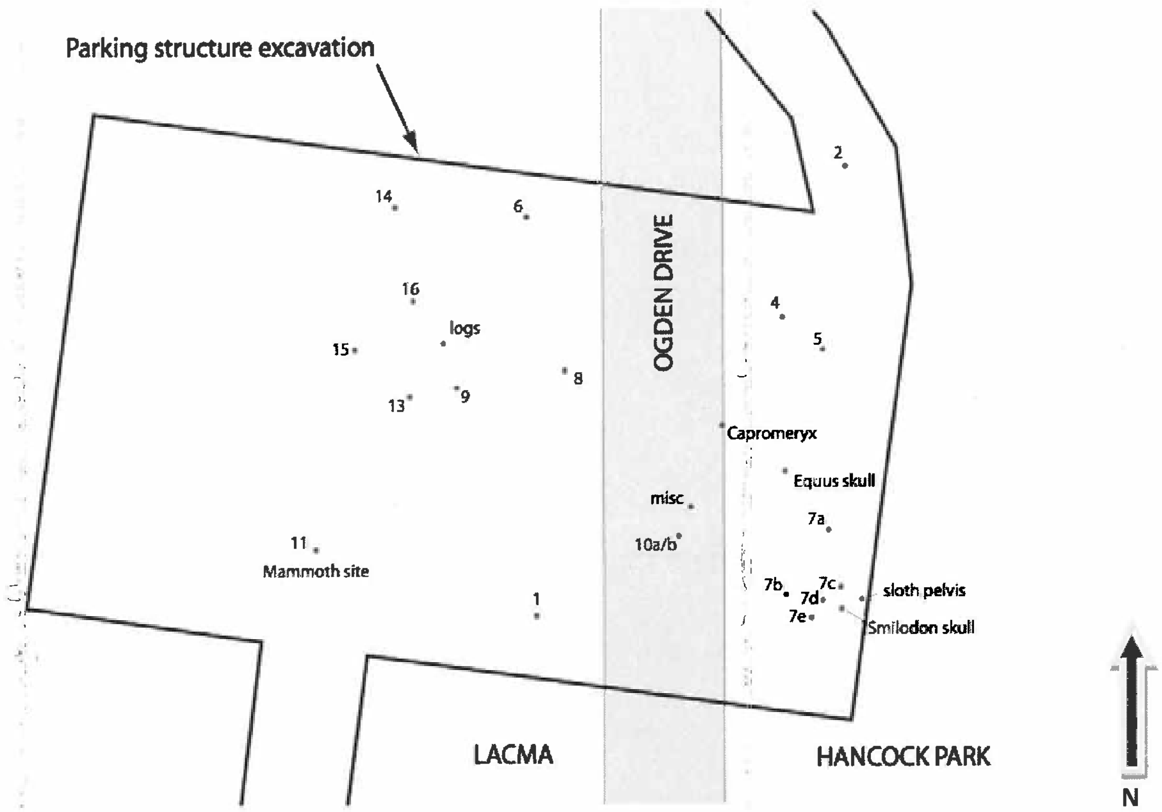
## Asphalt saturated conical shaped deposits

**Fig 4: Pedestal a deposit**

Once the extent of the fossil accumulation has been determined, the sediment surrounding the fossiliferous deposit is carefully removed, isolating the accumulation on a pedestal. It may be necessary for monitors to wear a SCBA, as in this image, because of the high concentrations of hydrogen sulfide.

**Fig 5: View of east end of LACMA construction site**

It is possible that there will be a number of fossil deposits within the construction site. Work may continue at non-fossiliferous locations while the deposits are being salvaged.




## Fig 6: Map of fossil localities from LACMA parking garage

These were mostly asphaltic fossiliferous masses but included some occurrences of isolated bones, trees, and other fossils.


**Fig 7: Fossil accumulation pedestals before tree box**

After the deposit has been isolated it will be surrounded by metal bands to conserve its integrity before the box is built and a brightly colored strong plastic or a tarp to keep the deposit dirt separated from the 'fill' dirt.

## Fig 8: Building a tree box around a fossil deposit

A custom sized box is then built around each deposit by a 'tree boxing' company. Valley Crest was used on the LACMA project. Any space between the plastic-wrapped deposit and the edge of the box must be filled with polyurethane foam, distinctly different sediment or gravel to preserve the integrity of the deposit and to prevent its deformation during subsequent transportation and storage. It is important that the 'fill' sediment be easily recognizable from the matrix during later excavation of the deposit.

**Fig 9: Secure the tree box with metal bands**

After the sides of the box are nailed into place, metal bands are added to secure and strengthen the sides of the box.

**Fig 10: Tunnel under the tree box**

After the sides of the box are secured and banded, the sediment beneath the box is removed by tunneling so that the box floor can be constructed. The field number and locality data must be clearly written on the outside of the box in permanent marker or paint. The orientation of the box and the depth below datum of the top and bottom of the deposit must also be clearly and permanently marked on the box, as well as added to the field notes for that deposit.

**Figs 11, 12 & 13: Relocating the tree boxes by crane and truck**

A crane is used to lift the completed boxes, load them onto a flat bed truck, and to relocate them to the place where their excavation will take place.

## Isolated fossils

In addition to conical and flat tabular asphaltic accumulations, construction activities may encounter isolated fossils in non-asphaltic or asphaltic sediments such as the trees, mammoth skeleton, and bison and horse skulls that were discovered during the recent construction of the LACMA's underground parking structure. Similar procedures pertain. The area must be roped off in order for the monitors to determine the extent of the fossil occurrence, which may then be removed using conventional paleontological field techniques.  Large or fragile bones must be pedestaled (with sediments immediately surrounding the fossil) and covered in a plaster and burlap jacket. The type of plaster used determines the time it takes to dry. Once the plaster is dry, it is flipped over and the other side is covered with plaster and burlap and left to dry completely. In the meantime paleontologists need to determine the extent of other isolated fossils in the area looking in particular for other elements of the skeleton of the jacketed specimen or sediments in which microfossils such as rodent, bird and reptile remains may occur.

It is crucial; that all isolated fossil occurrences be given a field number, their location recorded with a resource-grade GPS device, and these data entered into the field notes together with a map and description of the fossil, its orientation and its locality including description of the lithology in which the fossil was preserved. Standard guides such as Munsell Soil Color Charts should be used. The field number should be clearly and permanently affixed to the fossil and written on its container or jacket as appropriate. Maps must have a legend and scale to the show the orientation and depths of each fossil as well as a datum point. In addition to the field number, plaster jackets should also be marked "field side up" on the appropriate surface.

**Fig 14: Excavating isolated fossils**

Paleontologists need to excavate around large bones with hand tools before covering them with a protective plaster jacket for later removal and transport.

## Fig 15: Mammoth discovered

This image show the mammoth locality in the context of the construction site during the LACMA underground parking garage.

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# Attachment 2—Techniques for Excavation, Preparation and Curation of Fossils from the Project 23 Salvage at Rancho La Brea

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# ATTACHMENT 2

## Techniques for Excavation, Preparation and Curation of Fossils from the Project 23 Salvage at Rancho La Brea

# Techniques for excavation, preparation and curation of fossils from the Project 23 salvage at Rancho La Brea.

A MANUAL FOR THE RESEARCH AND COLLECTIONS STAFF OF THE GEORGE C. PAGE MUSEUM



2011

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# Introduction

This document was compiled mid project to record and codify best practices for excavation, preparation and curation of specimens from Project 23 and other Rancho La Brea localities that are housed in the George C. Page Museum. Some of the techniques are similar to Pit 91 excavations that were reported by Shaw (1982) and others that are unique to Project 23 because of the nature of the salvage. This provides guidelines for possible future salvage efforts. Documents discussing the nature of the mitigation are available elsewhere.

# Excavation Techniques for Project 23

Excavation of Project 23 deposits began in August, 2008. The measuring techniques used to determine and record data for *in situ* specimens follow those of Shaw (1982) for Pit 91 with some modifications described here (for instance, the imperial measurement system was used prior to Project 23). New excavation procedures have also been devised as a result of the removal of the deposits from their original location due to construction.

In Project 23, a custom-sized wooden box was built around each isolated plastic-wrapped deposit by a 'tree boxing' company (Valley Crest was used for this particular project). Any space between the deposit and the edge of the box was filled with either polyurethane foam or sediment to preserve the integrity of the deposit and to prevent its deformation during subsequent transportation and storage.

Because the deposits are no longer *in situ*, all excavation grids are oriented with respect to the deposits' original north orientation. Where feasible, box walls may be removed in part or in their entirety to allow excavation from the side of the deposit rather than from the top. Each "tree box" from Project 23 is treated differently depending on the type of deposit, size of the box and integrity of the sediments in the box. Refer to paleo mitigation protocol and ArchaeoPaleo report documents for descriptions on how the 'tree boxes' were constructed.

## Preparing a tree box for excavation

First read all the field notes pertinent to that particular deposit. In a field notebook or deposit logbook document the nature of the "box" size, construction, fill, plastic, etc. If the box is taller than 5 feet, erect scaffolding for excavators to safely access the box. Depending on the size of

the tree box it may be necessary to construct a safety railing extending upward from the sides of the box. After the top of the box is safe to access, remove the metal bands that are strapped across the top of box. Use specific snips if recommended by the tree boxing company. Remove supportive fill dirt, foam and plastic to reveal deposit surface, taking care to maintain an appropriate area for excavators to work safely.

Depending on box stability and size, board walls or portions of board walls may be removed to enable excavation from the side of the deposit. Smaller boxes containing deposits with cohesive sediments may allow the removal of all sidewalls. For larger boxes, removal of one wall or a small "window" cut into a sidewall may be feasible.

Before any asphaltic sediment is removed, set up a gas monitor close to where work will be conducted. The Solaris Multigas Detector is an economical, 4-gas instrument providing simultaneous detection of CO, O2, H2S and combustible gas and costs ~$600 from Safety Tek Industries.

## Grid layout

Determine the deposit's north side from field data and data written on the box.

Establish a datum point near the top of the box and record it based on field data. The datum point should not be removed during excavation.

Lay out grids into 1m x 1m squares with origin in the SE corner of the box using an alphanumeric system (N/S = A-Z; W/E = 1, 2, 3). Gridlines can be marked with string, spray paint or chalk and need to be refurbished and maintained periodically. A map of the box showing the grid lines and a north arrow should be drawn for reference.

## Excavation and Documentation

After grids are established, clean surface to remove fill dirt, to determine sediment type and to locate fossils if exposed. Note nature and location of fossils (bones, shells, plant remains, etc.)

Excavate grids in 25 cm spits (i.e. Level 1=0cm-25cm, L2=25cm-50cm, etc). If multiple grids are worked on at the same time, ensure that this doesn't compromise the mapping of each spit wall and floor. If a deposit has been exposed from the side, the spits in any one grid may be excavated sequentially from the top to the base of the deposit.

Depending on degree of consolidation, use small hand tools (hammers, chisels, and screwdrivers as required) on non-fossiliferous areas. Pneumatic or electric hammers can be used on areas with hard matrix where there are no fossils. Use dental picks and small screwdrivers to expose and extract fossils. Hard asphaltic matrix can be softened with clamp lamps or loosened with a small amount of solvent. Measure exposed fossils *in situ* (see below) within each grid and record their data in field notes before extracting them.

Note: Clamp lamps should be placed at least 8" away from the specimens and always monitored. Never leave lamps unattended. If the sediments start to smoke immediately turn off the lamp. 150 watt incandescent unfrosted bulbs should be used.

Save all of the surrounding sediments but separate them based on sediment type into 5 gallon metal buckets with lids. The pre-designated sediment types are A= asphaltic sand, B=brown silts and C=clay. Mark each bucket with box #, grid and level data as well as the sediment type (A, B or C). Note the number of buckets of each sediment type from each grid on an inventory list kept by the lead excavator. This is important because it determines how each bucket is processed later (see matrix processing section).

Keep daily documentation in field notes of who is excavating, a list of the grid or grids being excavated and describe the type of matrix being removed, what is being found within each grid, and any challenges encountered with the excavation. Geologic and paleobiological data should be recorded in field notes for later use to constrain and further refine taphonomic, paleoenvironmental, and paleobiological interpretations. A description of each lithology (soil type) should include color (fresh and weathered), lithologic composition, grain size, sorting and shape, sedimentary structures, induration, type of cement, fossil content, and pedogenic features (rooting, nodules, slickensides, etc.). As excavation proceeds note unit thickness, nature of the bounding contacts (erosional, sharp, gradational), and inferred depositional setting. Note nature and location of fossils (bones, shells, plant remains, etc.). Any visible modifications to the bones (weathering, polish, abrasion, scratch/tooth marks, root traces, borings, pitwear, breakage, distortion) and gross orientation should be recorded. Features of the matrix surrounding the bones, such as alteration halos, mineral crusts, micro-structures, fine root traces (small burrows or borings), and localized invertebrate bioturbation should be noted. The degree and nature of articulated, semi-articulated, associated, and dissociated skeletal elements should be described. Notes should also be taken on the general geometry of the fossil deposit (vertical pipe, tabular, etc.) drawings and/or photographs should be taken when appropriate.

## Measurement system

The most common types of macrofossils recovered from asphaltic deposits are isolated bones. The following measurement system has been devised for capturing data for individual bones.

See the Special Cases section for the treatment of associated skeletons, dermal ossicles, plant masses, etc.

*In situ* measurements are taken from specific anatomical points on each bone (see Table 1 and 2 Appendix A) to define its spatial orientation with reference to its depth below an established datum point (BD), its distance north (N) of the southern grid line and its distance west (W) of the east grid line using the metric system (see Fig 1. of Shaw (1982) but note this uses the imperial measurement system). Recording this data at the time of excavation will facilitate studies of stream current energy and direction, deposition, and taphonomy.

All identifiable bones from 1 cm to 2 cm in size should be measured *in situ* as a 1-point measurement before being excavated. Each Standard Measurement (BD, N, W) is taken to the center point of the longest dimension (Fig. 3)

Bones larger than 2cm in minimum length or diameter should be measured as either a 2-point or a 3-point measurement. The 3-point measurement is used on all bones in which three predetermined identifiable anatomical points are visible. The 2-point measurement is used if the bone lacks three distinct reference points and records the orientation of the long axis of the specimen (proximal-distal, anterior-posterior, medial-lateral, etc.). Detailed instructions for measuring out specimens are provided by Shaw (1982), which also lists the elements that generally fall into each of these categories.

All the data pertinent to the specimen should be recorded in the field notebook and should also accompany the specimen until its preparation and curation have been completed. One method of doing this is to duplicate the field notebook entries onto a 3" x 5" card using carbon paper (Fig 1, 2 and 3 below). This card then accompanies the specimen throughout its preparation, curation, and final cataloging. Only when the data have been recorded in the catalog are they separated.

In addition to measurements on individual bones, the dip of all limb bones and skulls should be recorded with a Brunton compass. Recording these data at the time of excavation will assist with interpretation of stream current energy and direction, and taphonomy which may include possible vertical movement in a vent, trampling, etc.

The soil type surrounding each measured bone should also be noted on the 3" x 5" card by a letter using a pre-designated lettering system. The pre-designated sediment types are A= asphaltic sand, B=brown silts and C=clay.

After a bone has been measured *in situ*, it is placed in an appropriate sized clear plastic bag. The 3" x 5" data card is placed in its own small clear plastic bag for safety and then placed in the bag with the bone.

**Fig 1: Example of excavation data for a 3-point measurement in a field notebook and transcribed onto a 3" x 5" card template.**

P23-14 B3/L4

| | GT | Px | Dt |
|---|---|---|---|
| BD = | 58cm | 53cm | 64cm |
| N = | 31cm | 35cm | 31cm |
| W = | 13cm | 10cm | 90cm |

*Canis dirus* femur

Soil type= A
Dip=30°SW
Excavator initials and date

**P23-14 = Project 23-Box 14**
**B3/L4 = grid B3/level 75cm-100cm**

**GT = Greater Trochanter is 58cm below datum, 31cm from the south grid axis and 13cm for the east axis**
**Px = Proximal end is 53cm below datum, 35cm from the south grid axis and 10cm from the east axis**
**Dt = Distal end is 64cm below datum, 31cm from the south axis and 90cm from the east axis**

**Soil type A= asphaltic sand**

**Fig 2: Excavation data for a 2-point measurement in a field notebook and transcribed onto a 3" x 5" card template.**

P23-1 B1/L2

| | Px | Dt |
|---|---|---|
| BD = | 53cm | 64cm |
| N = | 35cm | 31cm |
| W = | 10cm | 90cm |

Canid juv. radius

Soil type= B
Dip=1°SW
Excavator initials and date

**P23-1 = Project 23-Box 1**
**B1/L2 = grid B1/level 25cm-50cm**

**Px = Proximal end is 53cm below datum, 35cm from the south grid axis and 10cm from the east axis**
**Dt = Distal end is 64cm below datum, 31cm from the south axis and 90cm from the east axis**

**Soil type B= brown silt**

**Fig 3: Excavation data for a 1-point measurement in a field notebook and transcribed onto a 3" x 5" card template.**

P23-5B D3/L7

BD = 20 cm
N = 10cm
W = 15cm

Rodent tooth

Soil type=C
Excavator initials and date

**P23-5B = Project 23-Box 5B**
**D3/L7 = grid D3/level 150cm-175cm**

**20cm below datum**
**10cm from south gridline**
**15cm from east gridline**

**Soil type=clay**

Specimens smaller than 1 cm, fragments, or unidentifiable smaller bones are placed into "bulk matrix bags" together with field data cards (P23-deposit # and grid/level information, excavator initials and date). Because they are known to contain fossils, the bulk matrix bags will be processed before the rest of the matrix samples. Keep associated fragments together in capsules or envelopes within the bag. Be sure to always place delicate bones into snap cap vials first and then into a clear plastic bag with their data. If a fossil is not in place, identify it and label it "not *in situ*"

## Special cases

Each special case requires consultation by lab and collections staff to assess the best way of documenting each potentially unique occurrence.

- An articulated or associated skeleton should be extensively photographed. If, after consultation with Lab and collection staff this is removed as a small block, be sure to place a white pin in the top surface along the northern middle portion of the block so that it can be oriented later. Draw and annotate a diagram of the block and the elements that are visible on each surface before it is removed. Measure out the block as a 2-point measurement. Elements within the block that can be identified and measured without compromising the specimens should be also noted and can be measured using the 1 or 2-point measurement system but should not be removed from the block. Labeled copies of all photographs should be placed in the bag with the specimen. This is additional to downloading the photographs to the archive computer (see photography section). Articulated or semi-articulated specimens should be extracted in articulation and the sediments around the specimens stabilized to conserve the maximum amount of information derivable from the specimen.

- Bone masses with poorly preserved specimens (fragmented and/or less asphalt-impregnated) are more difficult to measure out individually. Measure out the extent of the mass with the 2-point system rather than the constituent bones. Place a white pin in the top surface along the northern middle portion of the block so that it can be oriented later. Photograph in situ specimens, print and label images and place them in the bag with the specimens.

- As instructed by Lab and collections staff, and depending on their nature and frequency, dermal ossicles and pockets of plant, shell or insect material should either be measured out as a small block with a 2-point measurement (same as above) or placed in pre-labeled bags with locality information for a specific 10cm square within the 1m x 1m grid.

## Geologic Samples

Collect 15 cm by 15 cm soil samples of each sediment type from each grid and level for geologic analysis of composition, weathering, and grain size at a later date. Document each sample in your notebook and measure each one *in situ* as a block using the 2-point measurement system used for fossils and described above. Each sample should have a white pin placed on the upper surface in the northern middle portion of the sample so that later the sample can be oriented. Transcribe all data onto a 3" x 5" card and place in a clear plastic bag with the soil sample. A list of soil samples taken should be kept by the lead excavator for each grid and deposit.

When spits are completed, photograph and map each exposed wall and the floor.

## Floor and Wall mapping

When mapping a wall or floor (Fig. 4, 5 and 6)

- Draw maps on graph paper with a scale of 3 squares = 10 cm.
- Keep the origin point (0, 0) in the southeast corner.
- Mark north arrow.
- Draw in empty spaces and the edge of the box when present.
- Mark asphalt and sediment contacts.
- Use standardized symbols for lithologies and other known sedimentary features. Also
- Indicate where fossils, cobbles, bone, shells and plants masses are located (Fig 4).

**Figure 4: Standard symbols used in mapping each grid's floor and wall**

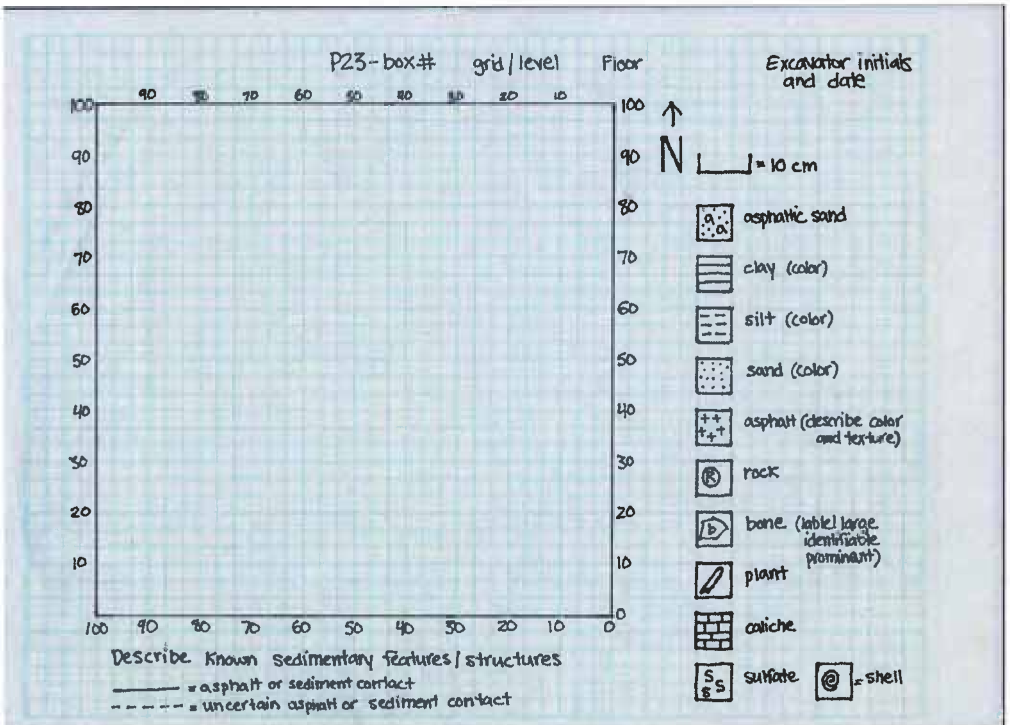



**Figure 5: Sample drawing of the floor of grid C3/L3 of box 14**

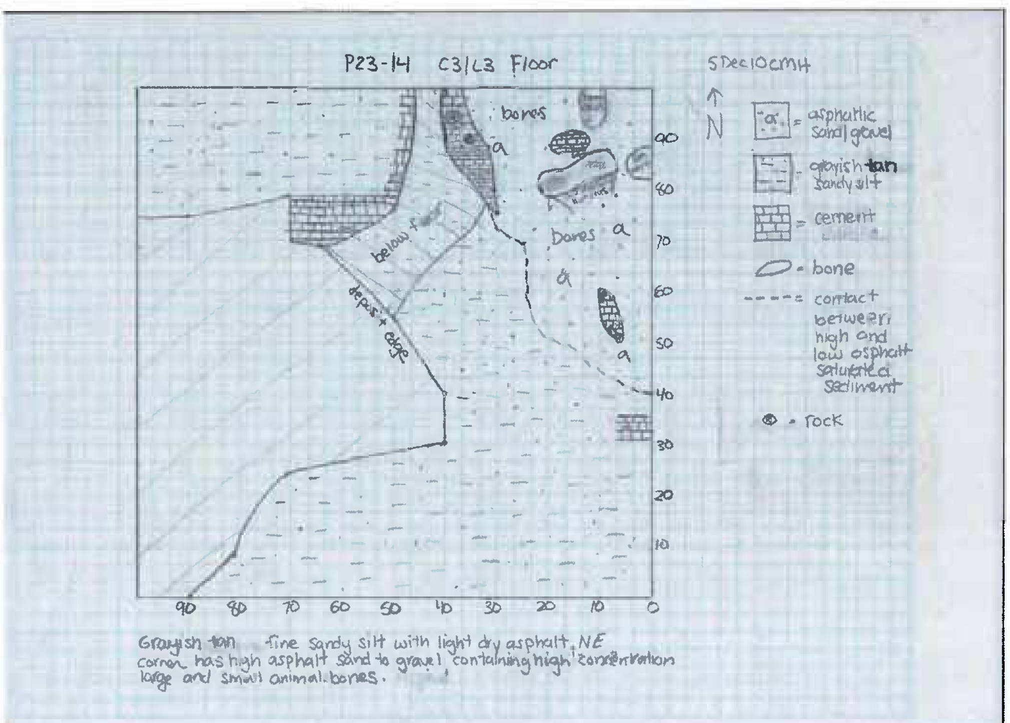
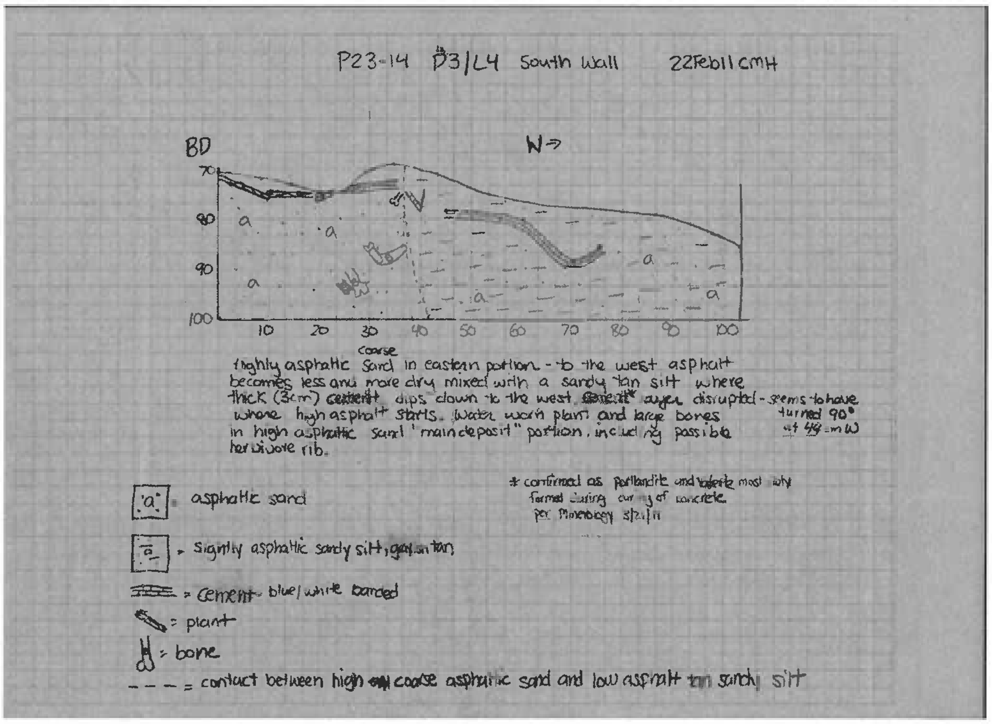


**Figure 6: sample drawing of the south wall of grid D3/L4 of box 14**




# Photography

Photo documentation and the labeling of downloaded images are very important. In the field photo logbook provided, record all the images that you take. This is shared by everyone and has columns for name of photographer, date, box #, grid and level, orientation of image, file number and special notes. Take a photograph whenever it might be useful for lab staff and researchers to see how a specimen was oriented in the ground, broken in a certain way or for any other unusual circumstance. Always photograph the floor and each wall of a grid before starting a new one.

<u>When photographing a specimen:</u>

Write the project name, box #, grid and level #'s, orientation, description of what you are photographing, the date and excavator initials on a 3"x 5" card with a black sharpie and place next to the object you are photographing.

For example:

P23-14 C3/L3

Skull , ventral view ↑

N

Excavator initials and date

Print the photo as soon as possible and place it in the bag with the specimen. This may not be necessary for all the images of *in situ* specimens, so make a judgment call here.

When photographing a floor or wall:

- Write the project name, box #, grid and level #'s, orientation, the date and excavator initials on a 3"x 5" card with a black sharpie.

For example:

P23-14 C3/L3

South Wall ↑

Excavator initials and date N

- Place meter sticks in north and west orientation.
- Take a picture of each exposed wall and floor with the card and meter sticks in frame so as not to cover up any significant features and so the information on the card can be used to tag the photograph in the database.

Download all photographic images to the archive computer and place in the folder "to be sorted" under My Pictures\Project23 under the project 23 login. Rename your files appropriately so that they can be retrieved, tagged in Adobe Bridge and added to the EMu database. This is where the photo logbook will be useful. Each image should be named with the following conventions in order to be searchable in the database:

1. If it is a photo of a grid and a level then name it P23-1 B1 L2 where P23-1 refers to the Box number, B1 refers to the grid and L2 refers to the level. Notice a space between P23-1 and B1 and also between B1 and L2. This is on purpose and helps the database find the files. If there is no level just enter the information that you have.
2. If it is just an image of several grids just name it with the box number e.g. P23-14.

3. If it is a photo of a possible associated skeleton or a specimen in the ground include some more information such as what it might be e.g. P23-1 B1 L2 bird skeleton

## Data entry of field notes

Write field notes in pre-bound notebooks. For each day compile a daily journal that includes notes on the weather, who was working, general work done that day, grids being worked on, etc. as well as geological information on open grids and specimen measurements. On a weekly basis all excavation notes, photographs and grid drawings will be captured electronically.

- Type journal entries into word documents with each day saved as a new file. The naming convention of the file should be "project yearmonthday initials" (e.g. P23 20090201 ABF). Within the word doc file at the top of the page type the initials of the excavator and the date. This serves as a search tool for the database. Save these to the flash drive that is provided. The Collections Manager will import these data into the database.
- Type specimen measurement data into a pre-prepared Excel spreadsheet and save to the flash drive provided. The Collections Manager will import these data into the database.
- The floor and wall drawings and photographs for each grid must be scanned and downloaded onto the archive computer at the Page Museum.

## Matrix processing

There are two different ways that matrix from the excavation is processed. All asphaltic matrix from or adjacent to asphaltic bone concentrations needs to be processed with solvent in a vapor degreaser in order to release small bones and other plant, insect, invertebrate and vertebrate remains from the asphalt. After degreasing, the matrix is dried and dry screened to remove the clay-to-silt fraction. The remaining concentrate is sorted for microfossils under a microscope.

Samples of other (apparently non-fossiliferous) non-asphaltic sediments are screen-washed in water on 20 mesh screens and the concentrates are sorted for microfossils under a microscope. If there is no evidence of microfossils in the sample, the remaining material from that facies of that grid may be discarded (except for the 15 cm archival cube that was collected during excavation of the grid).

## Laboratory Protocols

All material sent to the Lab for cleaning is triaged to resolve appropriate methodology, account for the skill level of available lab workers, and for research and collection priorities. An n-propyl bromide solvent is used to remove asphalt from the bones. Trade names for this solvent include Lenium, GenTech and EcoMax. Elmers white glue is used to repair broken bones and Acryloid (Paraloid) B-72 (Ethyl methacrylate copolymer) is occasionally used to consolidate dry bones.

## Prioritize new specimens

1. For cleaning method
    - Sort and store by locality, grid, depth.
    - Sub-sort by best cleaning method: ultrasonic, soaking, or hand prep.
2. For significance
    - Rareness of taxon
    - Incomplete section of previously excavated specimen
    - New element of known individual skeleton from that locality
    - Unrecognizable to element or taxon.

## Ultrasonic cleaning

Ultrasonic cleaning can be used for the following types of specimens:

- Complete or sturdy bones measured in individually (examples include *Smilodon* or *Canis dirus* carpals, tarsals, phalanges)
- Complete or mostly intact avian bones. The feasibility of processing other fragile bones, including broken small bones, should be assessed by the person who will be re-assembling them.
- Shells, insects, and concentrations of mollusks or insects from within known locality with measurements.

**Steps to be followed**

1. Place each specimen or sample in a baby food-sized jar with all contents of envelope.
2. With pencil, number the envelope and the <u>top</u> of the jar (on masking tape).
3. Prepare six jars as above.
4. Fill with solvent to an equal level in all jars.
5. Place in ultrasonic tank and fill with water up to the level of solvent in jars.
6. Buzz for fifteen minutes.
7. Strain contents of jar through 20 mesh screen on top of pitcher.
8. Rinse with clean solvent.
9. Check specimen or sample for matrix, detail with brush or skewer as needed.
10. Place each specimen or sample on separate paper tray, with flipped out matrix, data, and masking tape number from jar top.
11. Let dry over night, polish, and sort matrix.
12. Solvent that was strained into pitcher can be reused for setting up next batch of six jars if not too dirty.

## Pre-soaking

- Large bone masses: If there is no single identifiable bone, put it in a large jar or a bucket with more solvent than volume of mass. Mass may require a second rinse if solvent becomes too thick with asphalt.
- Unusually hard matrix: Put all of the specimen and loose matrix in jar with data taped to lid.
- Broken *in situ* specimens: If matrix is in internal structure of bone, soak and rinse.

## Hand preparation

- Individual specimens with positional data include vertebrae, ribs, long bones, etc. that are relatively complete.

**Steps to be followed**

1. Rubber stamp, date, and write the signature of preparator on back of data card.
2. Empty all contents of plastic bag or envelope into stainless steel pan.
3. Wet specimen with solvent from squirt bottle.
4. Scrub with tooth brush, dipped in small jar of solvent (n-propyl bromide)
5. DISOLVE MATRIX, DO NOT PUSH OFF WITH BRUSH OR OTHER TOOL.
6. Wood skewers or sticks can be used to loosen or nudge matrix off (If the stick breaks, the matrix is not soft enough yet)
7. When specimens appear clean, rinse thoroughly with solvent and immediately hold in front of vent for quick dry. Matrix still adhering to specimen will be black or darker than bone.
8. DENTAL TOOLS ARE TO BE USED FOR THE REMOVAL OF VISIBLE ROCKS ONLY!
9. When the entire matrix has been removed, place specimen, data card and jarred contents of metal pan matrix on paper tray lined with paper towels to dry.
10. DO NOT GLUE UNTIL ALL MATRIX IS SORTED.

- Multiple pieces of one specimen.

1. Should be prepared by one person but treated as separate projects.
2. Finished elements held until all parts are done.
3. If glued, the part that goes with which data should be recorded in pencil on back of data card.

- Possibly associated elements of one individual

1. Treat as above but can be cleaned by multiple preparators.
2. Label for possible association with a known skeleton or a single other element. [more specific].

- Skulls
    1. External surfaces should be freed of larger associated specimens and gross matrix clumps using toothbrushes and solvent.
    2. DO NOT POKE IN EARS, NOSE OR BRAIN CASE.
    3. At the end of session, immerse in solvent in sealable bucket with copy of data on lid.
    4. Soak for two or three days.
    5. Hold skull over bucket and flush with clean solvent to remove loose matrix.
    6. Working in metal tray, nudge with skewers to loosen softened matrix and rinse off.
    7. Add removed matrix back into bucket.
    8. Replace skull in bucket at end of session.
    9. If the tympanic bulla is intact, nudge and rinse ear region over metal pan and process matrix separately for ear ossicles.
    10. When brain case and nasal region are mostly free of matrix, skull will not need to continue to soak and can dry between sessions.
    11. Strain contents of bucket.

## Polishing

- When specimen has dried overnight, go over small sections of solid bone with a dampened **soft cloth**, then go over the same space with a dry cloth. Exposed cancellous tissue should be <u>blotted</u> with a damp rag. Not rubbed!
- If there are small spaces that cannot be reached with a rag use a pipe cleaner or Q-tip. Dip it in solvent and blot off some liquid before applying. IF THE SPECIMEN GETS DARKER OR BEGINS TO LEAK ASPHALT, IT IS TOO WET. Put aside for a day and begin again.

## Processing Matrix from Individual specimens

- Processing sediment that has been soaked in solvent. (most common situation)

1. Pour contents through 20 mesh screen sitting on funnel into carboy.
2. Rinse with clean solvent.
3. With one motion, flip contents onto paper toweling on a paper tray.
4. Make sure everything is out of jar and out of screen.
5. Place tray near vent to dry.
6. When completely dry, sift and put in appropriate sized jar for later sorting.
7. If matrix appears clumpy after sifting, re-soak in solvent.
8. If matrix appears dirty with clay or silt after sifting, soak in hot water with a small amount (1 tsp) of detergent)

- Processing soaked in water sediment.
  1. Pour contents of jar through 20 mesh screen in a basin in the sink.
  2. Agitate the screen in clean warm water.
  3. Flip contents onto newspaper and leave screen on top to thoroughly dry.

## Microfossil sorting

When the matrix from an individual specimen is clean and dry it is ready for microfossil sorting.

Take the entire project (specimen, data and matrix) to a sorting station.

Do not pour out more matrix than you have time to sort. Only 1½ to 2 Tbs. may take several hours.

1. Sifting
   - Always sift matrix before sorting even if it was sifted before putting in a jar.
   - Sift through a designated 20 mesh screen with 2 inch sides.
   - Shake back and forth, (not up and down) over a paper towel.

- Empty contents of screen onto a clean piece of white sorting paper and shape matrix into a pile.
- Discard the fine soil that went through the sifter.

2. Sorting
   - Examine matrix, several grains at a time, by moving it across the paper with a fine paintbrush.
   - Create a "discard pile" for sediment and oxidized asphalt.
   - Move bone, plant, shell and insect fossils into distinct piles on one side of the paper.
   - Create a "questions" pile for indeterminate fossils.
   - When the entire matrix has been categorized, review fossils and "discard pile".
   - Have a staff person double check sorting.
   - It may be necessary to examine some specimens under the microscope.
3. Temporary packaging of categories
   a. <u>If all of the matrix of a individual project is sorted</u>
      - Review bone and separate into three categories:
      - 1. Broken pieces of the main bone (put aside for possible gluing);
      - 2. Identifiable bones (put into individual capsules or plastic containers);
      - 3. Unidentifiable bone fragments (put into one capsule or larger container).
      - Review plant material (separate seeds and put into capsule) and put into glass vial.
      - Review insect and put into one capsule.
      - Review shell and put into one capsule.

   b. <u>If only a portion of the matrix is sorted</u>
      - Place complete identifiable bones in capsules.
      - Place all bone fragments, plant, insect and shell into their own labeled containers.

When a large project is complete, all of the bone fragments must be reviewed and sorted to the above categories. It will be necessary to look at the small bone fragments under the microscope to determine the final number of Identifiable bones.

## Gluing

DO NOT GLUE UNTIL ALL MATRIX REMOVAL, POLISHING AND MATRIX SORTING IS DONE.

Use white glue for reconstructing most bones because it is reversible with warm water.

If a specimen is shattered, first reconstruct it holding the pieces together with masking tape. Do not glue until all of the fragments have been tested in available holes. Determine where all the major fragments go first and then glue from one direction. Have small strips of masking tape cut before the glue is applied. Apply glue with stick or dental pick in small amounts to the broken edges. Tape glued pieces in place and/or balance in sandbox for drying. Allow large pieces to dry overnight.

## Envelopes for finished projects

A copy of the original data must be made for every identifiable bone and one copy each for vial containing plant, insect, shell and unidentifiable bone. A rubber stamp template for "Found in assoc. w/" data is stamped on the face of a #5 ½ coin envelope. An exact copy of the original is then filled in. Note: Do not change the tentative field identification that is part of the original data even if it is wrong. The back of the envelope is stamped with a template for the scientific identification. If an "assoc. w/ bone "or the plant fragment is too large to fit inside an envelope, it should be put in a small plastic bag with an envelope. The envelopes are stapled shut and the entire project is put in one large plastic bag.

The finished bag should include the main bone, fragments of the main bone that could not be glued on, the original data and all the "associated with" specimens.

## Pre-Curation

After the specimens have been cleaned, the microfossils sorted and put into individual capsules and individual envelopes have been made for each specimen with all of the provenance data written on each envelope (see laboratory procedures) they are sent to the curation station. Identification of all of the fossils takes place near the comparative collection in the lab in order to facilitate identification. The principal measured out specimen with its original 3"x 5" field data card is identified first. The card is stamped on the back with a custom stamp with Scientific Name, Element, Identifier, and Notes. The specimen is identified as much as possible but identifications necessarily range from class identification such as Aves to genus and species. The identifier also describes the element according to an established list of bone terminology. Then each of the microfossils associated with that main bone are also identified in the same manner. After all of the microfossils that accompany that main specimen are identified, they are placed in a clear plastic bag with a twist tie and sent to the cataloging station. Below are detailed step-by-step instructions on how to identify specimens.

For each specimen follow the steps below in the order given.

1. Choose a specimen from the 'to be identified' box. If several envelopes are fastened together you must keep them together and complete the work on all of them.
2. Check the bone to see if it is clean and that all broken pieces have been glued if possible. If the bone is not clean then do not proceed with that one and send it back to the lab
3. Identify the bone using the reference collection and write the identification on the back of the envelope or card in pencil. Only use paperclips to join envelopes together.
4. Check to see if the main identified bone is in the original envelope or with the original 3" x 5" card.
5. Send identified specimen to be cataloged

- Always put the comparative bone back in the box it came from!
- if you find a 'found in association with' envelope which is not still with its original envelope, find the original envelope and fasten them together
- put all tools away and empty bags and containers

## Associated groups

If there is more than one specimen in an envelope the principal bone for which the measurements were recorded should remain in the original envelope. The other specimens should be treated as follows;

- all plants in one envelope
- all insects in one envelope
- all shells in one envelope
- each identifiable bone in a separate envelope, along with any of its broken pieces
- all unidentifiable bone in one envelope
- all difficult to identify bones in one envelope

Use envelopes stamped "Found in Association with" and make a complete copy of the information from the original envelope on each one.

## Identifiable and Unidentifiable Specimens

Identifiable bone characteristics:

- presence of an articular surface
- cross-sectional shape
- foramina
- distinctive curves
- relative size combined with other features

Bones are rated in three different grades of how easy they are to identify

- identifiable
- difficult to identify
- unidentifiable

Double check all identifications

## Identification of Specimens

The back of each envelope is marked with a custom stamp (stamp in bold below). Identifications are printed in pencil. An example below

- **Scientific name:** *Smilodon* (use both genus and species if more than one species)
- **Element:** prox. rt. tibia
- **Special Notes:** Pathology
- **Identifier:** ABF

1. Avoid using terms such as "frag" or "portion". Use prox. or dist. if appropriate.
2. You must not abbreviate scientific names but you may use abbreviations for the elements as long as they are the ones listed in this manual.
3. When identifying skulls and mandibles always list the teeth that are present and if they are erupting, fully erupted or worn.
4. The format of the identification is very important. Do not invert the word sequence e.g. prox. rt. rib is correct but rib, rt. prox. is not.
5. For incomplete bones name both the bone e.g. XIII thoracic vert and either the represented part e.g. centrum or the missing portion, e.g., w/o right transverse process. Make sure that the identity of the bone and its qualifier are both listed.
6. Be specific about the identity of any represented epiphysis, e.g., proximal or distal epiphysis of a limb bone, or head epiph of lt femur or ant cent epiph of thoracic vert.

7. Ordinal numbers of ribs, vertebrae, metapodials and digits are written in Roman numerals e.g. rt. II rib or XII thoracic vert

8. Number of phalanges and teeth are written in Arabic numerals e.g. 2$^{nd}$ phalanx or rt. M1. Note that abbreviations for upper molars are written in upper case letters (I, C, P, M) whereas those for lower teeth are written in lower case (i, c, p, m). For clarity of handwritten entries, put a line below the number for upper teeth (e.g. P4/) and a line above the number for lower teeth (e.g. m/1).

9. The side, either left or right comes before a number e.g. rt. II metatarsal

10. There are two special cases:

    - Phalanges that can be precisely named include sloth phalanges, carnivore 'thumb' phalanges and bird carpal phalanges e.g. rt. 1$^{st}$ carpal phalanx, digit I

    - Teeth which can be specifically named e.g. lt. p2

11. Skull fragments: if the facial or cranial region of the skull is mostly intact this can be recorded as 'ant' or 'post' skull. However if there are only a few fragments the individual bones are named e.g. basisphenoid, occipital and rt. temporal or indicate if some parts are missing, e.g. post. skull w/o rt. occipital.

12. Juvenile specimens: it is important to note if an epiphysis is missing as the order of ephiphyseal fusion is used to detect the age of an animal. Also mark "juv." in the special notes section of the identification.

## Abbreviations chart for elements

| | | |
|---|---|---|
| Left: lt. | Posterior: post. | With: w/ |
| Right: rt. | Ventral: vent. | Without: w/o |
| Proximal: prox. | Dorsal: dors. | Juvenile: juv. |
| Distal: dist. | Medial: med. | Pathological: path. |
| Anterior: ant. | Lateral: lat. | Unidentifiable: unid. |

Difficult to identify: diff.

Zygomatic: zygo.

Epiphysis: epiph.

Diaphysis: diaph.

Tuberosity: tub.

Trochanter: troch.

Articular: artic.

Vertebra: vert.

Transverse: trans.

Process: proc.

Centrum: cent.

Prezygapophysis: prezyg.

Postzygapophysis: postzyg.

Incisor: I (upper) or i (lower)

Canine: C (upper) or c (lower)

Premolar: P (upper) or p (lower)

Molar: M (upper) or m (lower)

Deciduous: D

## Dental formulae for Rancho La Brea fauna

Dental formulae are a short hand way of indicating the number and kind of teeth that are present. The upper jaw is indicated first and the teeth are in order: incisor, canine, premolar, molar.

Ruminant artiodactyls

0,0,3,3 / 3,1,3,3

*(Antilocapra, Bison, Capromeryx, Odocoileus)*

Camelids

*Camelops:* 1,1,2,3 / 3,1,1,3

*Hemiauchenia:* 1,1,2,3 / 3,1,1-3,3

Peccaries

*Platygonus:* 3,1,4,3 / 3,1,4,3

Horses

*Equus:* 3,1,3,3 / 3,1,3,3

Tapirs

*Tapirus:* 3,1,4,3 / 3,1,4,3

Dogs and bears

3,1,4,2 / 3,1,4,3

*(Arctodus, Canis dirus, Canis latrans, Urocyon, Ursus)*

Cats

3,1,3,1 / 3,1,2,1

*(Felis atrox: Felis concolor: Lynx)*

Sabertoothed cats

*Smilodon:* 3,1,2,1 / 3,1,1,1

Skunks, weasels, & badgers

3,1,3,1 / 3,1,3,2

- Tympanic bulla
- Vomer

**Auditory ossicles**

- Malleus
- Incus
- Stapes

**Mandible**

- Angular process
- Coronoid
- Articular condyle
- Symphysis

**Hyoid**

- Basihyal
- Epihyal
- Thyrohyal
- Ceratohyal
- Stylohyal

**Teeth**

- Permanent upper and lower. Upper denoted by upper case abbreviation and lower by lower case abbreviation.
  - Incisor – I (upper) or i (lower)
  - Canine – C (upper) or c (lower
  - Premolar – P (upper) or p (lower)
  - Molar – M (upper) or m (lower)
- Deciduous upper and lower. Upper denoted by upper case abbreviation and lower by lower case abbreviation.
  - Incisor – DI (upper) or di (lower)
  - Canine – DC (upper or dc (lower)
  - Premolar –DP (upper) or dp (lower)

**Vertebra (e)**

- Atlas
- Axis
- Caudal
- Centrum
- Cervical
- Lumbar
- Neural spine
- Odontoid process
- Postzygapophysis
- Prezygapohysis
- Sacral
- Sacrum
- Thoracic
- Transverse process
- Wing

**Ribs**

- Capitulum
- Shaft
- Tuberculum

**Sternum**

- Manubrium
- Sternebra
- Xiphisternum

**Scapula**

- Acromium process
- Coracoid process
- Glenoid fossa
- Metacromion
- Spine
- Vertebral border

**Humerus**

- Deltoid tuberosity
- Entepicondylar foramen
- Greater tuberosity
- Head
- Lateral condyle
- Lateral epicondyle
- Lesser tuberosity
- Medial condyle
- Medial epicondyle

**Radius**

- Styloid process
- Radial tuberosity

**Ulna**

- Coronoid process
- Olecranon
- Semilunar notch
- Styloid process
- Radial notch

**Carpals**

- Cuneiform
- Trapezium
- Lunar
- Magnum
- Trapezoid
- Central
- Pisiform
- Unciform
- Radial sesamoid
- Scapholunar
- Scaphoid

**Metacarpal**

- Plantar tubercle

**Sesamoids**

- Proximal sesamoid
- Distal sesamoid

**Phalanges**

- $1^{st}$, $2^{nd}$, $3^{rd}$, $4^{th}$, $5^{th}$
- Carpal
- Tarsal

**Inominate**

- Acetabulum
- Iliac crest
- Ilium

- Ischial tuberosity
- Ischium
- Pubic symphysis
- Pubis

**Fabella**

- Lateral
- Medial

**Femur**

- Greater trochanter
- Head
- Lateral condyle
- Lateral epicondyle
- Lesser trochanter
- Medial condyle
- Medial epicondyle
- Neck
- Patellar track
- Third trochanter

**Patella**

**Tibia**

- Lateral condyle
- Medial condyle
- Medial malleolus
- Tibial tuberosity

**Fibula**

- Head
- Lateral malleolus
- Distal fibula (herbivore)

**Tarsals**

- Astragalus
- Calcaneum
- Cuboid
- Ectocuneiform
- Entocuneiform
- Mesocuneiform
- Navicular
- Sustentaculum
- Naviculocuboid

- Mesoectocuneiform

**Metatarsal**

- Plantar tubercle

**Non-articulating bones**

- Baculum (male)
- Dermal ossicle (sloth)
- Sclerotic ossicles (birds and lizards)
- Falciform (sloth)
- Tracheal ring (birds)
- Dermal scale (lizard)

**Variations for juveniles**

- Diaphysis – shaft of juvenile long bone
- Epiphysis – the unfused articular surfaces of juvenile bone

**Numbers**

- Ribs – roman numerals
- Metapodials – roman numerals
- Digits – roman numerals
- Phalanges – Arabic numerals—1$^{st}$, 2$^{nd}$, 3$^{rd}$, 4$^{th}$, 5$^{th}$, terminal

## Curation

In order to curate specimens into the collections of the George C. Page Museum, all of the above-mentioned steps for excavation, preparation, and identification must be followed. The field number, orientation measurements, and pertinent field notes and photographs are all integral parts of the specimen information and must be readily available. Each specimen will receive an individual catalog number that is first recorded in an archival catalog book and then entered into the electronic database EMu, which is stored on the Natural History Museum's server. Once cataloged, each specimen is stored taxonomically in the collections. Specimens are housed in metal or wooden drawers within standard metal Lane cabinets. On average each drawer holds about seventy five specimens and each cabinet contains nine drawers.

Based on a typical deposit for Project 23, a 1m X 1m x 25cm grid yields approximately 1000 macro-vertebrate specimens per one (1) cubic meter. Additionally each cubic meter can have up to 2000 micro-vertebrate fossils. A typical conical shaped deposit can be up to 30 cubic meters.

## Appendix A

Table 1. Anatomical codes used for orienting specimens in the 2- and 3-point measurement system.

| | |
|---|---|
| A -- Anterior | Px -- Proximal |
| P -- Posterior | Dt -- Distal |
| M -- Medial | Lt -- Left |
| L -- Lateral | Rt -- Right |
| D -- Dorsal | R -- Root |
| V -- Ventral | C -- Crown |

Table 2. Anatomical codes of osteologic points used for orienting specimens in the 3-point measurement system.

## MAMMALS

**Skull:**
- AP - Anterior Premaxillae
- OC - Occipital Condyles
- POP- Postorbital Process (Rt or Lt)

**Mandible:**
- A - Anterior
- CP - Coronoid Process
- P - Posterior

**Vertebra:**
- AC - Anterior Centrum
- ANS- Anterior Neural Spine
- NS - Neural Spine
- PC - Posterior Centrum
- TP - Transverse Process (Rt and Lt)

**Rib:**
- Dt - Distal
- GC - Greatest Curve
- Px - Proximal
- Tub- Tuberculum

**Scapula:**
- AP - Acromion Process
- CP - Coracoid Process
- D - Dorsal
- PA - Posterior Angle
- V - Ventral

**Humerus:**
- Dt - Distal
- LEP- Lateral Epicondyle
- MEP- Medial Epicondyle
- Px - Proximal

**Radius:**
- Dt - Distal
- Px - Proximal
- RT - Radial Tuberosity

**Ulna:**
- CP - Coronoid Process
- Dt - Distal
- Px - Proximal

**Innominate:**
- IC - Iliac Crest
- IS - Ischial Tuberosity
- PU - Anterior Pubic Symphysis

**Femur:**
- Dt - Distal
- FC - Fovea Capitis
- Px - Proximal

**Tibia:**
- Dt - Distal
- Px - Proximal
- TT - Tibial Tuberosity

**Fibula:**
- Dt - Distal
- LM - Lateral Malleolus
- Px - Proximal

**Calcaneus:**
- Dt - Distal
- Px - Proximal
- S - Sustentaculum

**Metapodial:**
- Dt - Distal
- PT - Plantar Tubercle
- Px - Proximal

## BIRDS

**Skull:**
Same as Mammals

**Mandible:**
Same as Mammals

**Vertebra:**
- NS - Neural Spine
- TP - Transverse Process (Rt and Lt)

**Sternum:**
- A - Anterior
- CA - Carinal Apex
- P - Posterior

# Attachment 3—Wilshire/Fairfax Station Construction. Paleontological Resources Extraction

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WESTSIDE SUBWAY EXTENSION PROJECT

# Wilshire/Fairfax Station Construction. Paleontological Resources Extraction.

December 2011

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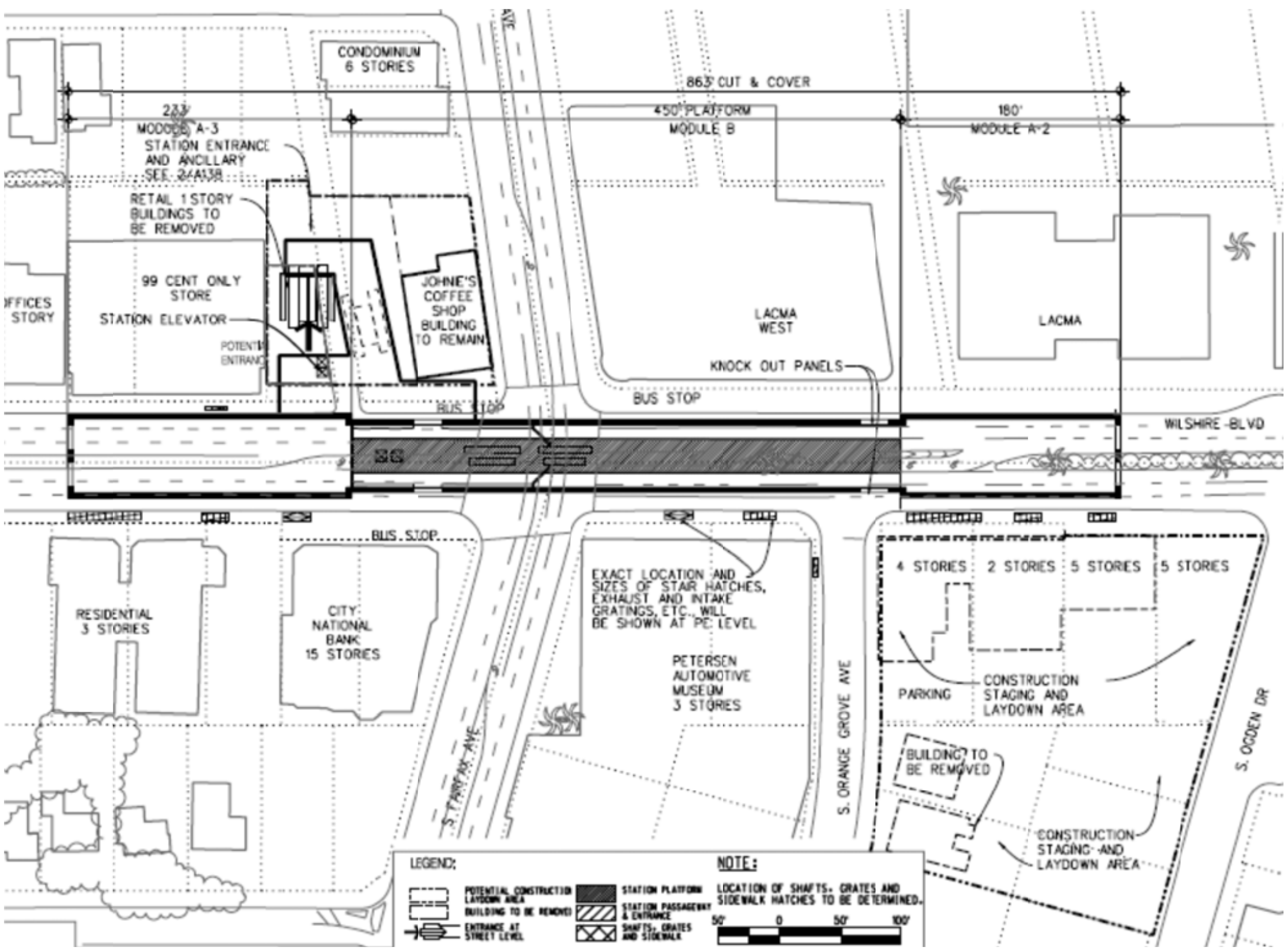
## Appendix

# 1.0 BACKGROUND

The Wilshire/Fairfax station box excavation will be approximately 860-ft long, 70-ft wide, and 60 to 70-ft below street level. The station extends beneath the intersection of Wilshire Boulevard and Fairfax Avenue - see Figure 1-1. The station entrance is planned to be located near the northwest corner of Wilshire and Fairfax between the 99 Cent Only Store and Johnie's Coffee Shop. Two alternative entrances under consideration; the south side of Wilshire between South Orange Grove Avenue and South Ogden Drive and; within the LACMA building at the north east corner of Fairfax Avenue and Wilshire Boulevard (May Company). A construction staging and materials laydown area is planned for the south side of Wilshire between South Orange Grove Avenue and South Ogden drive. Side access shafts will be located at the construction staging and materials laydown area and at the location selected for the station portal. The side access shafts will be excavated to the full depth of the station. The station box will be excavated by the cut and cover method and most probably use a temporary shoring system to support the excavation and decking system during construction, though a permanent shoring system that would be integrated into the permanent station structure could also be used. The side access shafts will be excavated by the open cut method and would most probably use the same type of shoring system that is used on the station box.

Figure 1-1: Wilshire/Fairfax Station Box



# 2.0 GEOLOGIC CONDITIONS

The geologic conditions in this region consist of soft alluvium deposits of sands, silty sand, clayey sand, gravely sand, silty clay, clayey silt, shell fragments, soil saturated with crude oil, and asphaltic (tar) sands. Several borings were taken within the station area; see Figure 2-1 through Figure 2-4. Core G-118 (Figure 2-1) was taken east of the station box between La Brea and Fairfax, the sample at 82-ft below ground surface (bgs) consists of silty clay/clayey silt with traces of crude oil. The portion of ring sample G-123 shown in Figure 2-2 is located just east of Fairfax at 60-ft bgs and consists of predominantly fine grained soil with channels of medium grained sand saturated with crude oil. Heavy tar was reported in G-123 from 38 – 110-ft bgs. Core sample G-124 (Figure 2-3 and Figure 2-4) was obtained just west of Fairfax by the Standard Penetration Test (SPT). The sample pictured was taken from 80-ft bgs and consists of medium to coarse grained sand saturated with tar. Heavy tar was reported in G-124 from 45 – 105-ft bgs. The consistency of tar in this region ranges from dry and hard to wet and oozing. This reach is also known to contain pockets of pressurized gases and dissolved gases in groundwater. The groundwater conditions are measured to have a water table depth of 74-ft bgs, and zones of perched water between 10 – 50-ft bgs. Since the station box invert depth will be located between 60 – 70-ft bgs, perched water can be anticipated during excavation.

Figure 2-1: Core Sample G-118

Figure 2-2: Core Sample G-123

Figure 2-3: Core Sample G-124 (1 of 2)

Figure 2-4: Core Sample G-124 (2 of 2)

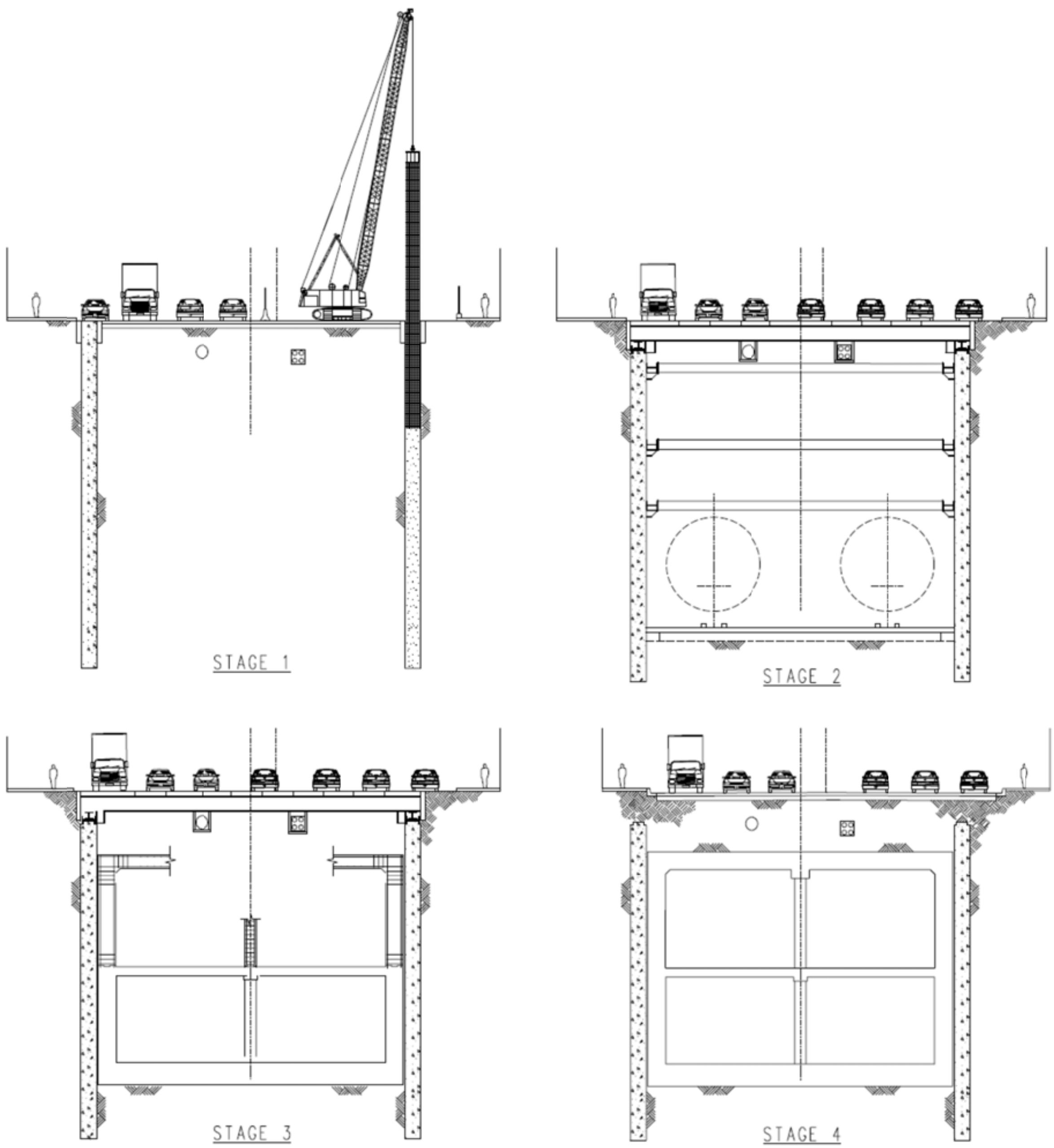
## 2.1 Gassy Ground Conditions

The gases present in the soils of this region are methane ($CH_4$) and hydrogen sulfide ($H_2S$). They are likely to occur in pressurized pockets as well as in a dissolved state in groundwater. These gases can seep into tunnels and other excavations through soil and also through discontinuities (fractures, faults, etc.) in bedrock. $CH_4$ and $H_2S$ are considered hazardous gases due to their explosive properties. $H_2S$ is also highly toxic. Being heavier than air, it tends to accumulate at the bottom of poorly ventilated spaces. Although very pungent at first, it quickly deadens the sense of smell, so potential victims may be unaware of its presence. $CH_4$ is extremely flammable and may form explosive mixtures with air. It is odorless and lighter than air, and it dissipates quickly once at the surface causing no threat of explosion. However, in 1985 an explosion occurred at the Ross Dress-for-Less in the Fairfax area which resulted in injuries requiring hospital treatment of twenty-three people. The explosion took place in a poorly ventilated ancillary room of the building where $CH_4$ gas had accumulated. There was no gas detection equipment at this location.

# 3.0 EXCAVATION SUPPORT TECHNIQUES

Cut and cover excavation is the preferred technique to excavate the station box structure, although cut and cover still leads to lengthy occupation of streets with noise disturbances and interrupted access (see Figure 3-1). Traffic interruptions can be mitigated by performing most excavation below a temporary decking system constructed at an early stage (See Figure 3-2 through Figure 3-6).

Figure 3-1: Open Cut Excavation



Shoring the excavation walls and providing structural support beneath the decking system can be accomplished through a variety of excavation support techniques. The following sections describe several excavation support methods, including: soldier pile and lagging, slurry walls, tangent piles, secant piles, and deep soil mix walls.

Figure 3-2: Initial Excavation at Soto Station


Figure 3-3: Precast Concrete Decking


Figure 3-4: Installation of Decking (1 of 2)

Figure 3-5: Installation of Decking (2 of 2)

Figure 3-6: Roadway Operations Restored on Temporary Decking System

## 3.1 Soldier Piles and Lagging

Soldier pile and lagging walls are a type of shoring system typically constructed along the perimeter of excavation areas to hold back the soil around the excavation. This support system consists of installing soldier piles (vertical structural steel members) at regular intervals and placing lagging in between the piles to form the retaining structure. Pre-augering is necessary for installation of the soldier piles. Pre-augering involves drilling holes for each pile from the street surface to eliminate the need for pile driving equipment and thereby reduces project noise and vibration levels that would otherwise occur while pile driving. Pre-augering also provides better accuracy of location than pile driving. The lagging, which spans and retains the soil between the piles, is typically timber or shotcrete (sprayed-on concrete) and is installed in a continuous downward operation taking place concurrently with excavation. The installation of soldier piles and lagging is a relatively clean process. The majority of construction materials, such as, drilled earth spoils, concrete, backfill, and H-piles are easy to contain within the construction site. The soldier piles and deck beams are installed first with excavation and lagging installation taking place from beneath the street decking. A soldier piles and lagging earth retention system is shown in Figure 3-7 through Figure 3-9. The equipment required for installation of the soldier piles includes drill rigs, concrete trucks, cranes, and dump trucks.

Soldier piles and lagging are generally used where groundwater inflow is not a consideration, or where grouting, or lowering of the groundwater level (dewatering) can be used to mitigate water leakage between piles. Based on findings from core samples, the geologic conditions in this area consist of soils containing deposits of oil and tar. Where these deposits occur along the excavation perimeter, oil or tar may tend to seep between the joints in the lagging. This is not considered to be a hazard to workers, although some cleanup may be necessary. Alternatives to soldier pile and lagging walls being considered for this station include tangent pile or secant pile walls, slurry walls, and deep soil mix walls (see next sections below).

Figure 3-7: Pre-augering for Soldier Pile


Figure 3-8: Cut and Cover with Soldier Pile and Lagging

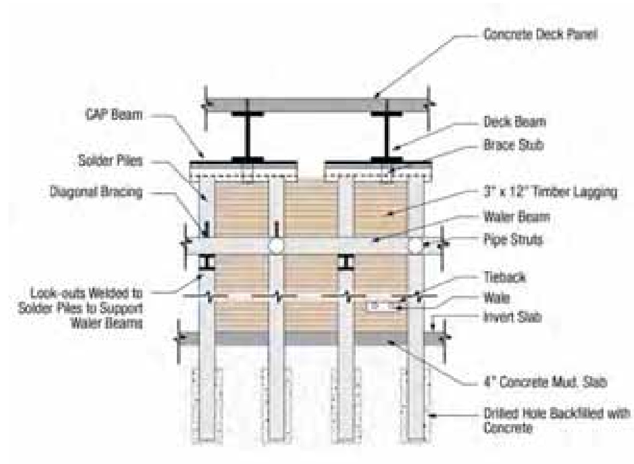
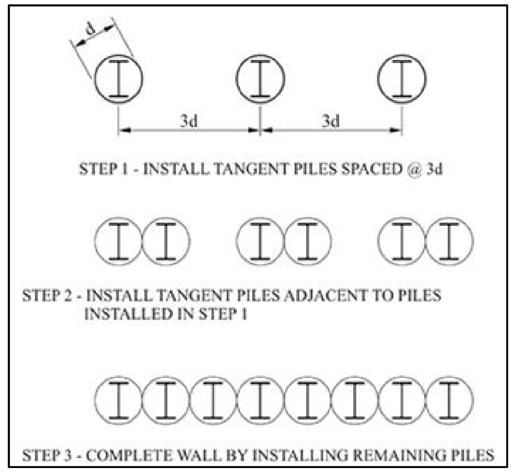



Figure 3-9: Soldier Pile and Lagging

## 3.2 Tangent Pile or Secant Pile Walls

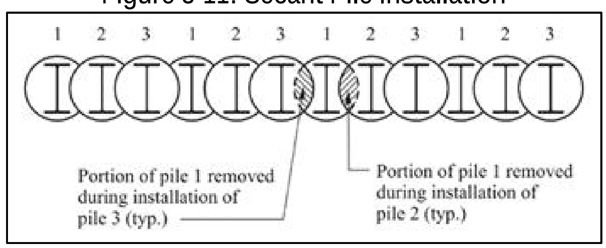
Figure 3-10: Tangent Pile Installation




Tangent pile walls consist of contiguous cast-in-drilled-hole (CIDH) reinforced concrete piles – see Figure 3-10. The contiguous wall generally provides a better groundwater seal than the soldier pile and lagging system, but some grouting or dewatering could still be needed to control leakage between piles.

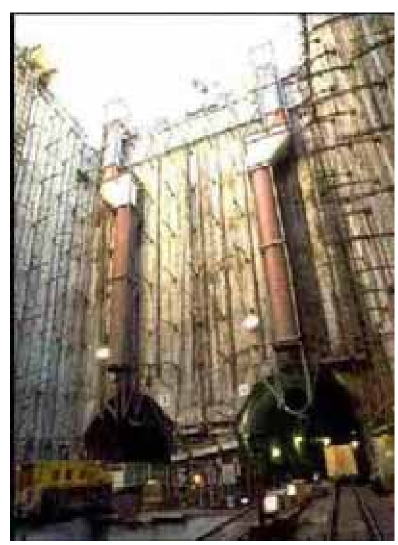
A secant pile wall system is similar to the tangent pile wall but the piles have some overlap, facilitating better water tightness and rigidity - see Figure 3-11. This method consists of boring and concreting the primary piles at centers slightly less than twice the pile diameter. Secondary piles are then bored in between the primary piles, prior to the concrete achieving much of its strength.

Figure 3-11: Secant Pile Installation




In terms of relative cleanliness, tangent pile and secant pile walls are comparable to one another and both are more difficult to contain than soldier piles and lagging due to the greater amount of pumped concrete and the expected larger diameter of drilled holes. The completed secant pile wall for the Barnsdall Shaft in Hollywood for the Metro Red Line project is shown on Figure 3-12. Secant and Tangent pile shoring systems are slower to construct that soldier pile and lagging and therefore have the disadvantage of requiring longer lane closures on Wilshire while they are being constructed. Furthermore, because of the close spacing of tangent piles, utilities crossing the wall often require relocation whereas a soldier pile system can often be built around the existing utilities. The equipment required for installation of the tangent pile or secant pile walls includes drill rigs, concrete trucks, cranes, and dump trucks.

Figure 3-12: Secant Pile Wall at Barnsdall Shaft on Metro Red Line



## 3.3 Diaphragm/Slurry Walls

Diaphragm walls (commonly known as slurry walls) are structural elements used for retention systems and permanent foundation walls. Use of slurry wall construction can provide a nearly watertight excavation, eliminating the need to dewater. Slurry walls are constructed using deep trenches or panels which are kept open by filling them with a thick bentonite slurry mixture. After the slurry filled trench is excavated to the required depth, structural elements (typically a steel reinforcement cage - see Figure 3-13) are lowered into the trench and concrete is pumped from the bottom of the trench, displacing the slurry. Figure 3-14 and Figure 3-15 illustrate slurry wall excavation equipment.

Tremie concrete is placed in one continuous operation through one or more pipes that extend to the bottom of the trench. The concrete placement pipes are extracted as the concrete fills the trench. Once all the concrete is placed and cured, the result is a structural concrete panel. Grout pipes can be placed within slurry wall panels to be used later in the event that leakage through wall sections, particularly at panel joints, is observed. The slurry that is displaced by the concrete is saved and reused for subsequent panel excavations.

Figure 3-13: Steel Reinforcement Cage for Slurry Wall

Slurry wall construction advances in discontinuous sections such that no two adjacent panels are constructed simultaneously. Stop-end steel members are placed vertically at each end of the primary panel to form joints and guides for adjacent secondary panels. In some cases, these members are withdrawn as the concrete sets. Secondary panels are constructed between the primary panels to create a continuous wall. Panels are usually to full depth and 8 – 20-ft long and vary from 2 – 5-ft wide.

Figure 3-14: Slurry Wall Construction Equipment

Figure 3-15: Clamshell Digger for Slurry Wall Construction

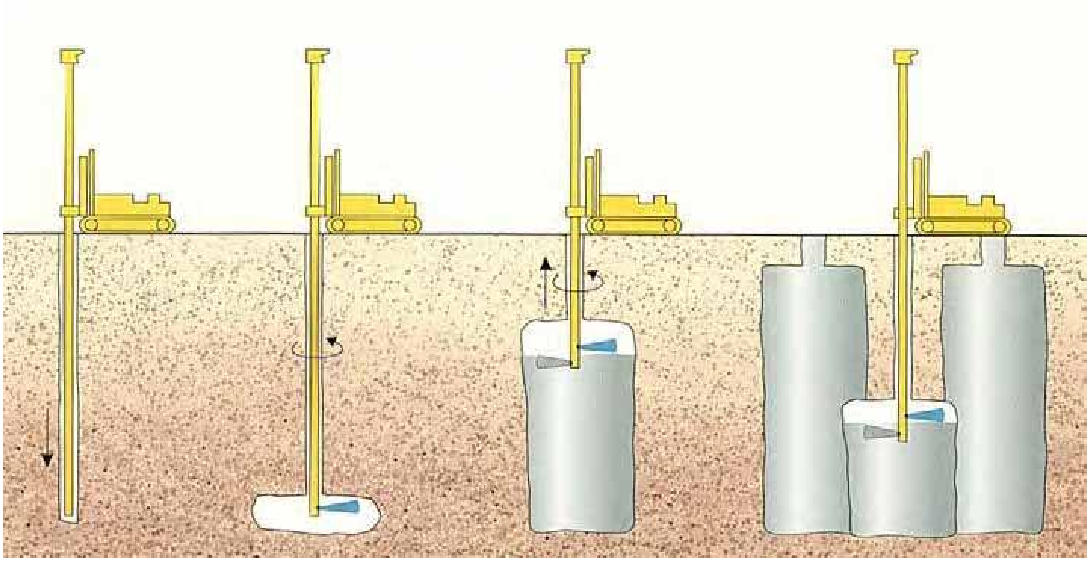
Similar to other shoring systems, slurry wall construction would occur in stages, working on one side of the street at a time. These walls have been constructed in virtually all soil types to provide a watertight support system in addition to greater wall stiffness to control ground movement. Because slurry walls are thicker and more rigid than many other shoring methods, the walls may in some cases be used as the permanent structural wall, although this application is not anticipated for this project. Where slurry walls are used, the thickness of the permanent structural walls can sometimes be reduced, i.e. when compared to wall thicknesses used with a conventional soldier pile and lagging system after removal of internal bracing.

Slurry wall construction materials are the most difficult to contain within the construction site of all the shoring types being considered due to the inherent messy nature of bentonite slurry combined with the operational characteristics of the clamshell digger which will likely be used to excavate large volumes of soil from the wall trench. Slurry walls are generally not adaptable to utility crossings and all utilities crossed by the wall would require temporary or permanent relocation. The equipment required for installation of the slurry walls includes clamshell or rotary head excavators, concrete trucks, slurry mixing equipment, cranes, slurry treatment plant, and dump trucks. The bentonite slurry would require disposal after a number of re-use cycles. Slurry walls are also slow to construct and will be very disruptive to traffic on Wilshire Boulevard.

## 3.4 Deep Soil Mix Walls

Deep soil mix walls are another type of temporary or permanent shoring system for deep excavation. Mechanical soil mixing is performed using single or multiple shafts of augers and mixing paddles. See Figure 3-16. The auger is rotated into the ground and slurry is pumped through the hollow shaft feeding out at the tip of the auger as the auger advances. Mixing paddles blend the slurry and soil along the shaft above the auger to form a soilcrete mixture with high shear strength, low compressibility, and low permeability. Spoils come to the surface comprised of cement slurry and soil with similar consistency to what remains in the ground. Steel beams are typically inserted in the fresh mix to provide structural reinforcement. A continuous soil mix wall is constructed by overlapping adjacent soil mix elements. Similar to secant pile walls, soil mix elements are constructed in alternating sequence; primary elements are formed first and secondary elements follow once the first have gained sufficient strength.

Figure 3-16: Deep Soil Mix Construction



Deep soil mix wall construction materials are also difficult to contain. Most of the construction process is performed by a single piece of equipment which mixes cement and soil in situ. Cement and soil mixture can be expected to escape beyond the confines of the drilling operation creating problems for traffic and pedestrians. The equipment required for installation of deep soil mix walls includes multi-shaft drill rigs, concrete trucks, cranes, and dump trucks.

## 3.5 Comparison of Excavation Support Techniques

Due to the speed of construction, and the ability to work around utilities, soldier piles and lagging is preferred unless site conditions dictate the use of other methods. See Table 3-1 for a comparison of excavation support methods. Soldier piles and lagging is the predominant shoring system used in the Los Angeles area and has been used successfully by Metro on construction of both Red and Gold Line stations. Experience at the LACMA parking garage excavation suggests that soil off-gasses immediately after being exposed but with a short period of time, the off gassing slows to levels acceptable for work. This suggest that the relatively impervious seal achieved by slurry walls, secant piles, and deep soil mix walls may only provide very short term benefits and that gas entering the station box excavation through a soldier pile and lagging system could be controlled with a well designed ventilation system.

Since it is anticipated that gassy soils will be encountered regardless of shoring system type, various methods of providing a safe and hazard free workplace will be implemented in all situations. No matter which type of temporary shoring system is selected; other measures such as, partially open decking, ventilation, gas detection, and Personal Protective Equipment (PPE), will be in use to protect workers from gases that may enter the excavation site.

Table 3-1: Comparison of Excavation Support Types

| Shoring Method | Permeability | Installation Duration | Containment Impacts | Noise / Vibration Impacts | Traffic Impacts | Utility Impacts | Business Impacts |
|---|---|---|---|---|---|---|---|
| Soldier Pile & Lagging | High | concurrent w. excavation | Low | Moderate | Moderate | Moderate | Moderate |
| Slurry Wall | Low | 3 Months | High | Moderate | High | High | High |
| Secant Pile | Low | 3 Months | Moderate | Moderate | High | High | High |
| Tangent Pile | Moderate | 3 Months | Moderate | Moderate | High | High | High |
| Deep Soil Mix | Low | 3 Months | Moderate | Moderate | High | High | High |

## 3.6 Construction Staging

For all types of shoring, the contractor would first occupy one side of the street to install one line of excavation support piles or wall panels. The installation will require extended closures of 2 – 3 traffic lanes on the side of the street where the equipment would be staged. After installation of piles or walls on both sides of the street at the station excavations, piles or walls would then be installed across the street at the station ends. This operation would also require lane closures, and is often done during night-time or weekend periods. The contractor would then proceed with installation of deck beams, installation of the deck panels and excavation and bracing. Deck panels (decking) allow continued traffic and pedestrian circulation since they will typically be installed flush with the existing street or sidewalk levels though raised decking, which requires less excavation during installation is being discussed with the traffic authority. Raised decking does have particular advantages at Wilshire / Fairfax Station as less excavation during the weekend closures while installing the decking makes it less likely that fossils will be encountered during the decking operation.

Deck installation will require successive full road closures on weekends with traffic detours. The decking would be installed in stages, commensurate with the amount of decking that can be installed during a weekend closure. Typical decking installation rates range from 50 -100 ft / weekend for an installation crew. Multiple crews will be used wherever possible to reduce the number of full road closures

## 3.7 General Approach to Handling Utilities

Prior to beginning construction of shoring and decking, it will be necessary to relocate, modify or protect in place all utilities and underground structures that would conflict with excavations. The contractor will verify locations through potholing methods and where feasible, the utility will be relocated so as to stay out of station or other surface structure excavation. Where the utility cannot be relocated outside the excavation footprint, it will be exposed and hung from the supporting structure (deck beams) for the roadway decking over the cut-and-cover structure. See Figure 3-17 and Figure 3-18.

Figure 3-17: Utilities Hung from Deck Beams

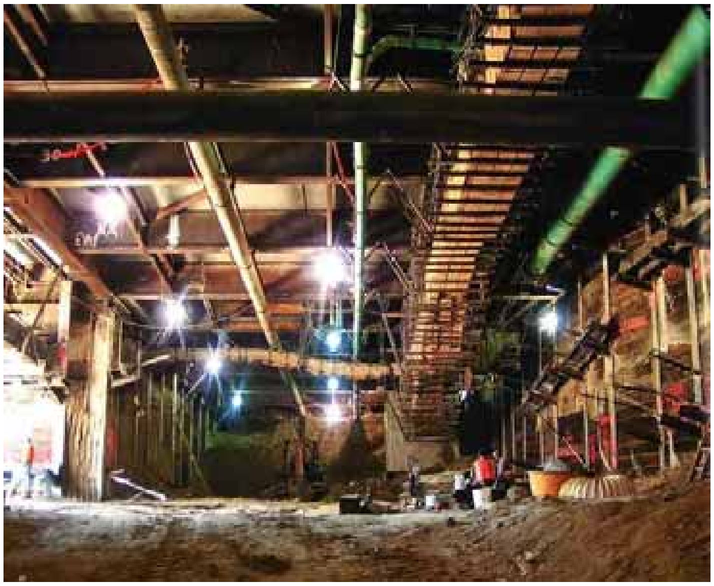


Figure 3-18: Utilities Hung from Deck Beams (Close Up)

Shallow utilities, such as maintenance holes or pull boxes, which would interfere with excavation work, will require relocation. The utilities alignments will be modified and moved away from the proposed facilities. Utility relocation takes place ahead of station and other underground structure excavation. During this time, it will be necessary to close traffic lanes.

It is possible that in some instances, block-long sections of streets would be closed temporarily for utility relocation and related construction operations. Pedestrian access (sidewalks) would remain open and vehicular traffic would be re-routed. Temporary night sidewalk closures may be necessary in some locations for the delivery of oversized materials. Special facilities, such as handrails, fences, and walkways will be provided for the safety of pedestrians.

Minor cross streets and alleyways may also be temporarily closed but access to adjacent properties will be maintained. Major cross streets would require partial closure, half of the street at a time, while relocating utilities.

Figure 3-19: Backfilling Utilities in Final Location beneath Road Surface

Utilities, such as high-pressure water mains and gas lines, which could represent a potential hazard during cut-and-cover and open-cut station construction and that are not to be permanently relocated away from the work site, would be removed from the cut-and-cover or open-cut area temporarily to prevent accidental damage to the utilities, to construction personnel and to the adjoining community. These utilities would be relocated temporarily by the contractor at the early stages of the operations and reset in essentially their original locations during the final backfilling above the constructed station. See Figure 3-19

# 4.0 PALEONTOLOGICAL ISSUES

The Wilshire/Fairfax Station is situated within the vicinity of the Hancock Park Rancho La Brea Tar Pits. The San Pedro Sand layer exists beneath the older and younger alluvium deposits near the surface in this region. This formation has a high likelihood for producing significant paleontological resources. The existing La Brea Tar Pits immediately adjoining the Wilshire/Fairfax Station site is the largest collection of fossils of extinct mammals in the entire world. Because of the high likelihood of fossil discovery while excavating the Wilshire/Fairfax station box, station construction at Wilshire/Fairfax will be given the maximum time available within the overall project schedule, so that excavation can proceed slowly and carefully and fossils located and removed without schedule pressures.

Before fossil recovery can begin, utility relocation and shoring for the station excavation using one or more of the shoring methods outlined above must occur. Utility relocations, by their nature (narrow trenches beneath paved streets) will make recovery of fossils during this phase of the work unlikely. Then, any fossils that lie within the footprint of the shoring will necessarily be destroyed when the shoring is constructed, as there is no way to remove them in advance of the shoring. However, shoring will at worst occupy less than 10% of the footprint of the station excavation, leaving 90% of the footprint unaffected and suitable for fossil recovery.

The plan for fossil removal has been based on the methods used by the Page Museum for the removal of fossils from the nearby LACMA parking garage excavation, referred to from here-on by the Page Museum name, Project 23. The ground will be excavated in shallow lifts, with museum staff on land to inspect the excavated surfaces as earth is removed and to mark the locations of fossils when discovered. It is assumed that the fossils will occur in a manner similar to that at Project 23, i.e. concentrated in vertical tar “pipes” which, once located, can be boxed in place and then removed from the site for further analysis. As with Project 23, fossils can also be found away from the tar pipes so all excavated surfaces must be inspected, and the contractor’s team must be alerted to the possibility of finding fossils anywhere with the excavation. The Project 23 site was an open excavation, not constrained by a deck at ground level. This made boxing and removal of the fossil boxes a good deal more straight-forward than will be the case at Wilshire/Fairfax. Figure 4-1 shows fossils in a pit at the Page Museum, and Figure 4-2 a boxed “pipe” containing fossils being prepared at the Project 23 site. Figure 4-3 and Figure 4-4 show examples of fossils recovered from Project 23 after processing.

Figure 4-1: Tar Deposit Containing Fossils

Figure 4-2: Fossil Box Construction at Project 23

Figure 4-3: Smilodon (Sabre Tooth Cat) Pelvic Bone

Figure 4-4: Smilodon Skull in Fossil Box

## 4.1 Minimize Excavation Done Before Decking Installation

Although the Project 23 experience suggests that fossils will mainly be 10 ft or more below street level, fossils must be anticipated anywhere within undisturbed ground. Using the cut and cover excavation technique, deck beams which support the deck panels are installed in the road bed after the piles or shoring walls are complete. The top of the deck beams sit just below the roadway surface so that the decking is flush with the roadway. The deck beams are approximately 6-ft tall and joined together with cross bracing so a minimum of 7-ft of excavation is required for their installation. On Red line and Gold Line stations, contractors have normally excavated 10 ft deep when installing the deck beams to provide clear space beneath the beams for better access when commencing to dig out from beneath the decking and to expose utilities immediately below the deck beams.

Because the street decking requires a full street closure to install, only limited times are available in which to close the street. Full street closures, especially along Wilshire Boulevard will be limited to approximately 52 hours duration on week-ends, and this will not provide time to carefully remove soil in layers to expose fossils nor to box and remove any fossils found in this initial excavation. Therefore, opportunities for fossil recovery from the initial excavation for the street decking will be limited. It therefore requires a construction approach to try and reduce the depth of the initial excavation. Two strategies are being pursued in this regard. One approach is to use raised decking so that the bottoms of the deck beams can be raised up by the same height that the station decking is installed above street level. Metro is in discussions with traffic authorities regarding the acceptability of using raised decking at Fairfax. See Appendix A for details of raised decking. The other approach is to use shallower deck beams, either for a flush deck system or in conjunction with a raised decking approach. Shallower beams will almost certainly require installing the deck beams at closer centers, probably 7 ft centers instead of the usual 14 ft centers but the shallow beams will reduce the likelihood of finding fossils during decking.

It should be noted that many utilities in the street are much deeper than the bottom of the deck beams, and any fossils would have been destroyed during the construction of such utilities. Utilities already have disturbed a significant percentage of the station excavation footprint, and this will increase with the relocations required prior to the installation of the shoring and decking. Nevertheless, there will remain areas of undisturbed soil within the 10 ft immediately below street level and fossils therefore could be found in these locations. These areas can be mapped in advance so that they can be excavated carefully.

## 4.2 Excavation of the topmost layers beneath the street decking

Once the street decking has been installed, excavation beneath the decking will commence. The side access shaft(s) from the contractor's laydown area (see Figure 4-5) and from the station portal site will be excavated in shallow lifts, using methods similar to those of Project 23. Any fossils found will be removed. Once the side access shafts are deep enough to allow equipment to commence digging beneath the street decking, equipment will be lowered into then shaft to commence digging. One scenario will be for the contractor to dig the initial lift by scraping down the face, using low headroom equipment such as a Gradall (see Figure 4-6) or other equipment acceptable to Metro and to the Page Museum. The working face would be inclined at probably a 2:1 slope and would be accessible for inspection (see Figure 4-7). The excavation would proceed in this manner until the first lift was completely removed. The height of the first lift will be determined by the head room needed by the equipment needed for the subsequent lifts, but probably of the order of 12-14 ft. depending on the equipment selected, subsequent lifts could continue to be inclined or horizontal. Fossils and tar pipes containing fossils would be removed under the supervision of Page Museum staff, probably using the boxing techniques developed for Project 23. Because the Fairfax Station will be decked, handling large boxes beneath the decking will be very difficult. Boxes of not more than 500 cubic ft (approximately 30 tons) are proposed as an upper limit, and smaller boxes for the first lift below the decking may be necessary so that low headroom equipment will be able to carry the boxes back to the side access shaft. Actual box sizes can be determined in the field by the contractor and paleontologists. Figure 4-7 and Figure 4-8 show the proposed excavation sequence.

Figure 4-5: Open Cut Excavation of Side Access Shaft

Figure 4-6: Gradall Excavator - East Side Access Project NYC

Figure 4-7: Cross Section Showing Excavation Procedure of Shallow Lifts at 2:1 (Approx) Slope Beginning from the Side Access Shaft

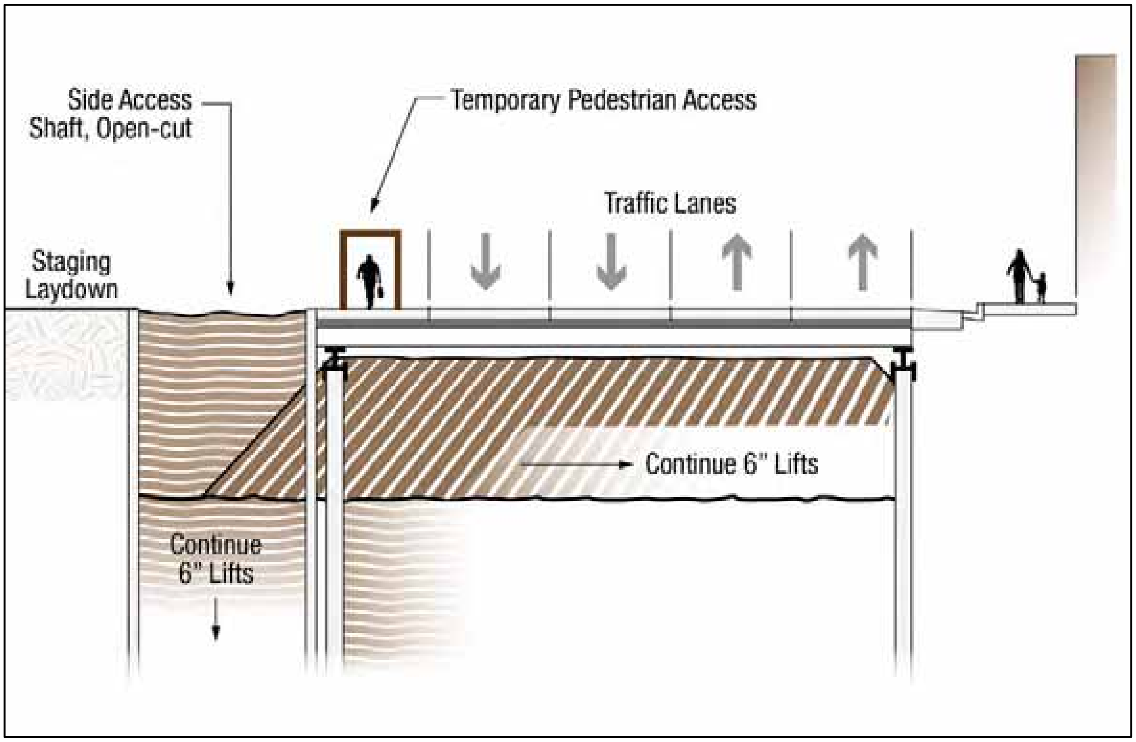
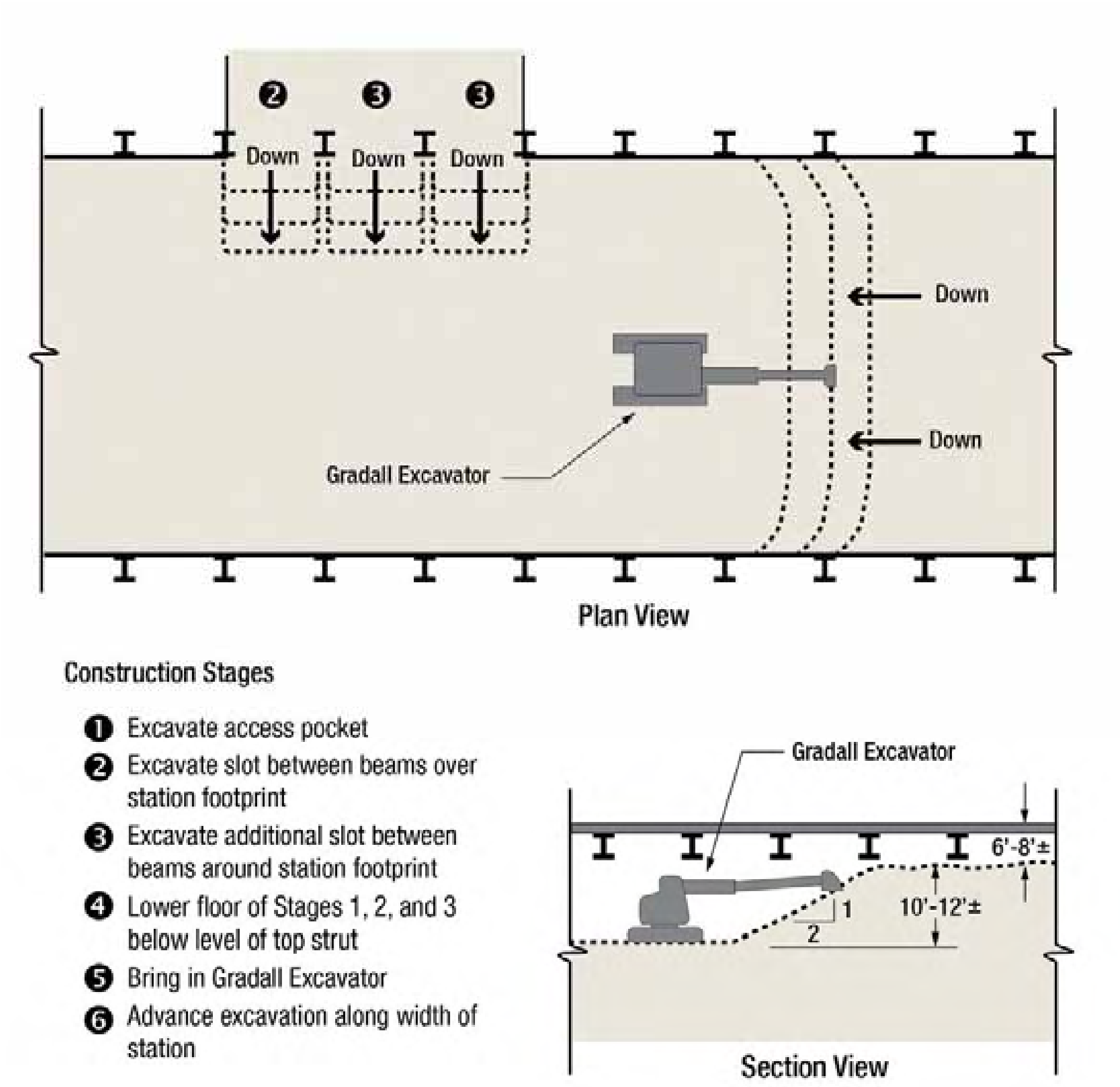


Figure 4-8: Plan Showing Excavation Procedure of Shallow Lifts with Low-Profile Gradall Excavator



## 4.3 Excavate in Layers

The station box and side access shafts will be excavated in shallow lifts to carefully expose and locate fossils. The Page Museum is suggesting 6” lifts based on experience at the Los Angeles County Museum of Art (LACMA) parking garage. As with Project 23, fossils can also be found away from the tar pipes so all excavated surfaces must be inspected,  and the contractor’s team must be alerted to the possibility of finding fossils anywhere with the excavation.

Compact track loaders and compact excavators (see Figure 4-9 and Figure 4-10) are likely necessary for initial soil removal directly beneath the deck beams due to their low vertical clearance, and relatively small bucket size capable of excavating precise lifts. Continuous tracks improve vehicle traction on soft and sticky terrain and reduce the amount of pressure exerted on the soil below. A pressurized although this may not be an option due to tight clearances and proper ventilation will still be needed regardless. If soil conditions permit, a rubber tire vehicle like skid steer loaders or equipment fitted with floatation tires may be used instead of compact track loaders. Gradalls operate a bucket at the end of a telescopic arm in a linear motion. The linear shoveling motion enhances depth control improving the ability to cut in precise shallow lifts. These will be considered considered as well. Track loaders, wheeled dozers and hydraulic excavators would be employed to remove the bulk of the soils in order to maintain efficiency in excavating (see Figure 4-11 through Figure 4-13. Excavation with these tools will require careful observation to identify the location of tar deposits. When tar deposits are located, smaller equipment should step in to avoid damaging fossil resources with heavier machines.

Figure 4-9: Compact Track Loader

Figure 4-10: Compact Excavator – 6.75’-Tall/12’-Long/6.5’-Wide

It is possible that the discovery and removal of fossils could lead to schedule delays and the station box structure would not be completed in time to precede the TBM breakthrough. As long as station box excavation has not breached a reasonable depth above where the top of the tunnel liner will be so that it would compromise the operation of the TBM, then the TBM drive should continue through the station box location and station excavation would work its way down and eventually break through the tunnel liner.

Figure 4-11: Tracked Loader Removing Muck from Beneath Struts

Figure 4-12: Hydraulic Excavator between Struts

Figure 4-13: Track Loader beneath Struts

It may be possible to use an imaging technique to locate fossils ahead of excavating operations thus allowing the pace of excavation to accelerate beyond the recommended 6" lift limit. If the imaging technique produces a reliable indication, the boxing of fossils can be pre-planned. Some techniques of scanning for objects below the surface that should be considered are Ground Penetrating Radar (GPR), HAARP Detection using ELF and VLF radio waves, electrical resistivity imaging, and geophysical diffraction tomography.

If an Early Work Authorization is obtained, construction can begin on an exploratory shaft to test the effectiveness of the anticipated geophysical methods. The shaft could be located within the limits of a side access shaft and would ideally reach full station depth in order to learn as much as possible from this process. The length and width of the shaft should be a minimum size to allow a variety of the equipment under consideration to perform excavation operations during the exploration process. Construction methods will be tested to determine the best techniques and tools for station box excavation. Shoring types will be tested to determine the effectiveness of the planned shoring in the soils present in the area. Gas levels will be measured to gauge the specifics of the ventilation scheme.

## 4.4 Fossil Box Size

As layers of soil are removed, tar-laden sand deposits containing fossils are likely to be uncovered. When this happens, work is halted within proximity of the fossil to allow the paleontologists on site to assess the discovery and begin preparations for boxing and removal of the deposit. The technique of boxing and removing fossil deposits to an off-site facility for additional paleontological work is an efficient process that was first implemented at the La Brea Tar Pits in 1915 and more recently during the construction of Project 23. A photo of the 1915 boxing method is contained on Page 8 of Rancho La Brea, Death Trap and Treasure Trove, Edited by John M. Harris, June 2001.

Figure 4-14: Fossil Boxes at Project 23

The box construction technique used on Project 23 is similar to that which is used for boxing palm trees for transport. See Figure 4-14. First, the paleontologist defines the location of the fossil deposit. Next, trenches are dug around the sides and excavation continues by removing sterile soil from around the fossil zone with heavy equipment leaving an island where the deposit sits. The bottom of the box is most challenging. After the box is supported by blocks and shims at each of the four corners, workers must crawl beneath the box and dig by hand while inserting the timber boards which make up the base of the box (Figure 4-15). An alternative approach to creating the bottom of the box which would improve worker safety and expedite the excavation process would require an auger to drill holes in the island beneath the fossil deposit. Timbers would be inserted through the auger holes, thus beginning to form the base of the box. The auger would then remove the balance of soil between the timbers allowing completion of the box and freeing the deposit from the soil below. See Figure 4-16. During the excavation of Project 23, sixteen tar deposits were discovered. From the sixteen deposits, twenty-three boxes were recovered, thus giving the parking garage project its name. The boxes range in size from 5x5x5-ft (weighing 3 tons) to 12x15x10-ft (weighing 56 tons).

Figure 4-15: Fossil Relocation Process. (From Page Museum Whiteboard)

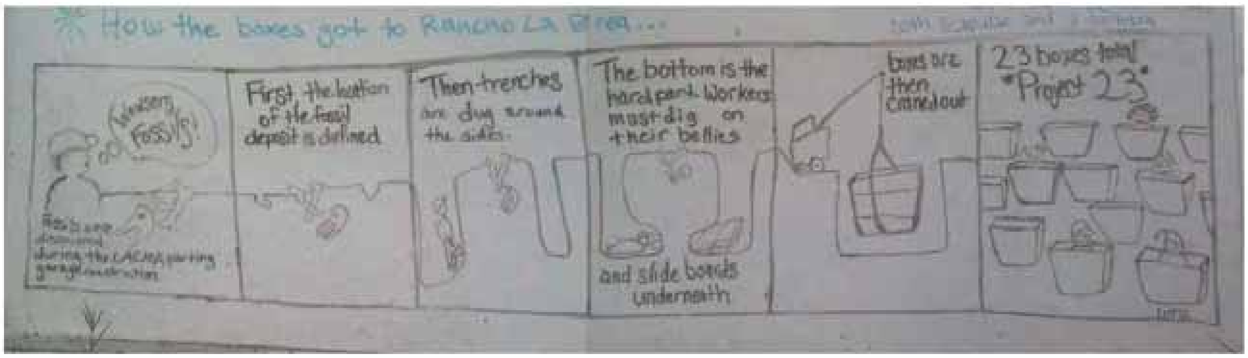
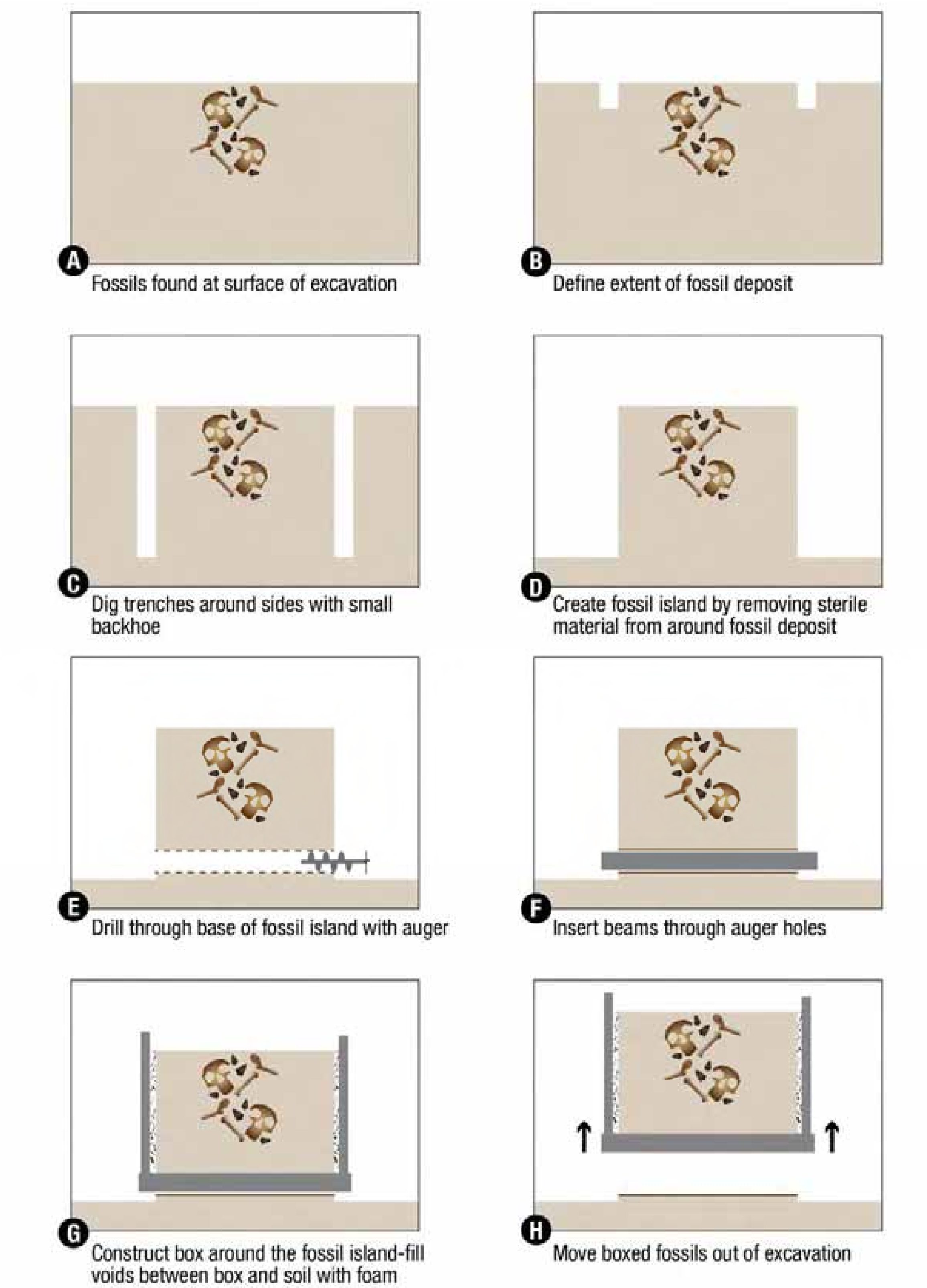


Figure 4-16: Proposed Alternative Boxing Technique Using Auger for Floor Construction



Depending on the size and weight of each box, fossils located beneath deck panels may be lifted in place by crane through temporary openings in the decking. However, this may prove to be impossible if street closure is not possible or the crane cannot be positioned on the street decking in a way to perform the lift. It is proposed to limit the size of fossil boxes to about 30 tons, i.e. 500 cubic feet which will make boxes easier to lift or to move around below the decking with low headroom equipment or with a system of skids and temporary tracks constructed within the station box. Once positioned adjacent to the side access shaft, fossil boxes can be lifted by mobile cranes positioned on "terra firma". The crane would lift the box out through the access shaft and load it on a truck which will transport the tar and fossils either to the Page Museum site where paleontologists can continue their work or to the contractor's laydown area at South Orange Grove/ Ogden for storage and processing. Offsite processing is preferred as there is less potential for damage by heavy equipment that will be operating at the South Orange Grove/Ogden laydown area.

## 4.5 Construction Issues in Tar-Laden Soils

The asphaltic sands have unique properties and the engineering characteristics are not as well documented as compared to other soils. However, contrary to common expectations, it is proven that these sands possess shear strength. Design parameters for excavation support systems in asphaltic sands will need to consider some additional pressure due to the makeup of these soils. There are numerous cases of successful experience in construction of deep basements and underground parking structures in the Wilshire/Fairfax area soils, such as construction of underground structures at LACMA (see Figure 4-17). Similar design elements, construction techniques and operating methods and procedures can be applied to the planned excavations.

Figure 4-17: Aerial View of Project 23 Excavation with Dark Tar Seeps

## 4.6 Potential Impacts to Construction Methods from Anticipated Tar-Laden Soils

When excavating in tar-laden soil, efforts will be undertaken to avoid excessive disturbance. Excavation methods will be closely controlled to minimize over-excavation or vibrations. When grade is achieved within these soils, a mud slab could be applied to minimize disturbance. In some cases, a layer of gravel may be placed over the asphaltic sands to increase traction and reduce the amount of soil compaction caused by construction traffic. The contractor can also apply various other materials on top of the tar such as cement, lime, or other additives to prevent it from fouling the tracked equipment. Wide tracked machinery can be used to reduce the pressure exerted on the soils below. Timber mats can make a sturdy foundation to drive equipment on. Rubber tire vehicles are considerably lighter than their tracked counterparts and could be operated with floatation tires specifically designed to minimize the amount of soil compaction caused by heavy equipment. Because the tar is rather sticky or tacky in some areas, it is anticipated that the equipment's tracks, axles, or buckets could become fouled and would require occasional cleaning. Steam cleaners would handle the task well, by heating the tar to a less viscous consistency.

## 4.7 Handling Gas Intrusions during Construction Operations

Previous projects in the Methane Risk Zone have been successfully and safely excavated. Multiple underground parking garages have been constructed in this area. For example, LACMA built a two-level subterranean parking structure in the Methane Risk Zone, previously referred to as Project 23. During the excavation, H2S (above safe working levels) was encountered on several occasions. Workers donned PPE to protect against exposure during these events (se Figure 4-18). Further investigation of operating underground structures will be undertaken during future design phases to assess effectiveness of barrier systems and detection equipment used.

Figure 4-18: Fossil Boxes with Worker Donning Oxygen Respirator at Project 23

Since the majority of gas is expected to enter the excavation through the excavation surface, the release of gases may be constricted by applying a ground cover to all areas except the area where current excavation operations are taking place. An impervious membrane of Visqueen plastic sheeting or geotextile fabric may serve this purpose.

In areas of potential H2S exposure, there are a number of techniques that can be used to lower the risk of H2S release or exposure. Because station excavations are less confined than tunnels, gas exposure issues are anticipated to be less significant. Although pre-treatment of the ground water prior to excavation, with additives such as hydrogen peroxide or copper-zinc, is an option, it is not expected to be required. If released, H2S will not naturally dissipate because it is heavier than air, hence it would build up around the bottom of the excavation. The first line of defense is dewatering since H2S occurs in a dissolved state in ground water. Dewatering will remove any contaminated water from the excavation area. At the surface, a sealed tank would capture the water and treat the air for H2S off-gassing before discharging it to the surrounding environment. Additionally, a ventilation system will be used to introduce fresh air in the workspace. Fans will be used to circulate the air while a gas detection system monitors levels of hazardous gas. A suction system fitted with scrubbers may be required to collect H2S from the bottom of the excavation and treat the air before discharging clean air at the street surface.

CH4 is a hazard in confined spaces. As such, it is essential that workers be sufficiently protected, and thus detection and monitoring equipment would be required. Fans similar to those used to dilute H2S concentrations would also dilute CH4 concentrations in the station box. Once above-ground, CH4 dissipates rapidly in the atmosphere and would not be a health hazard.

## 4.8 Ventilation Schemes

Ventilation is required to combat harmful or dangerous gasses when present in underground construction. Cal OSHA classifies subterranean work areas as “gassy”, “potentially gassy”, “non-gassy”, or “extra hazardous”. Excavation equipment in “gassy” spaces must be manufactured to resist accidental sparks and either be sealed or of explosion proof design.

Since CH4 and H2S gases are expected to be encountered during the excavation of Wilshire/Fairfax station, adequate ventilation and continuous air quality monitoring will be in use throughout construction. In addition to maintaining acceptable levels of CH4 and H2S in the air supply, the ventilation system must maintain a certain level airflow for workers present in the work space (see Figure 4-19) . The size of the system is dependent on the number of persons and the size of diesel equipment underground. The air supply shall not be less than 200 CFM (cubic feet per minute) per person underground, plus 100 CFM per diesel horse brake power.

Use of perforated deck panels, either perforated steel or concrete integrated with steel could be used in place of concrete only deck panels to allow the free flow of air between the excavation area and the surface, especially if full decking is required across the entire station box.

Figure 4-19: Underground Ventilation Ducts

# 5.0 CONCLUSIONS AND RECOMMENDATIONS

The project is committed to recover fossils and to work closely with the Page Museum to minimize the loss of fossils due to the construction of a station at Wilshire/Fairfax.

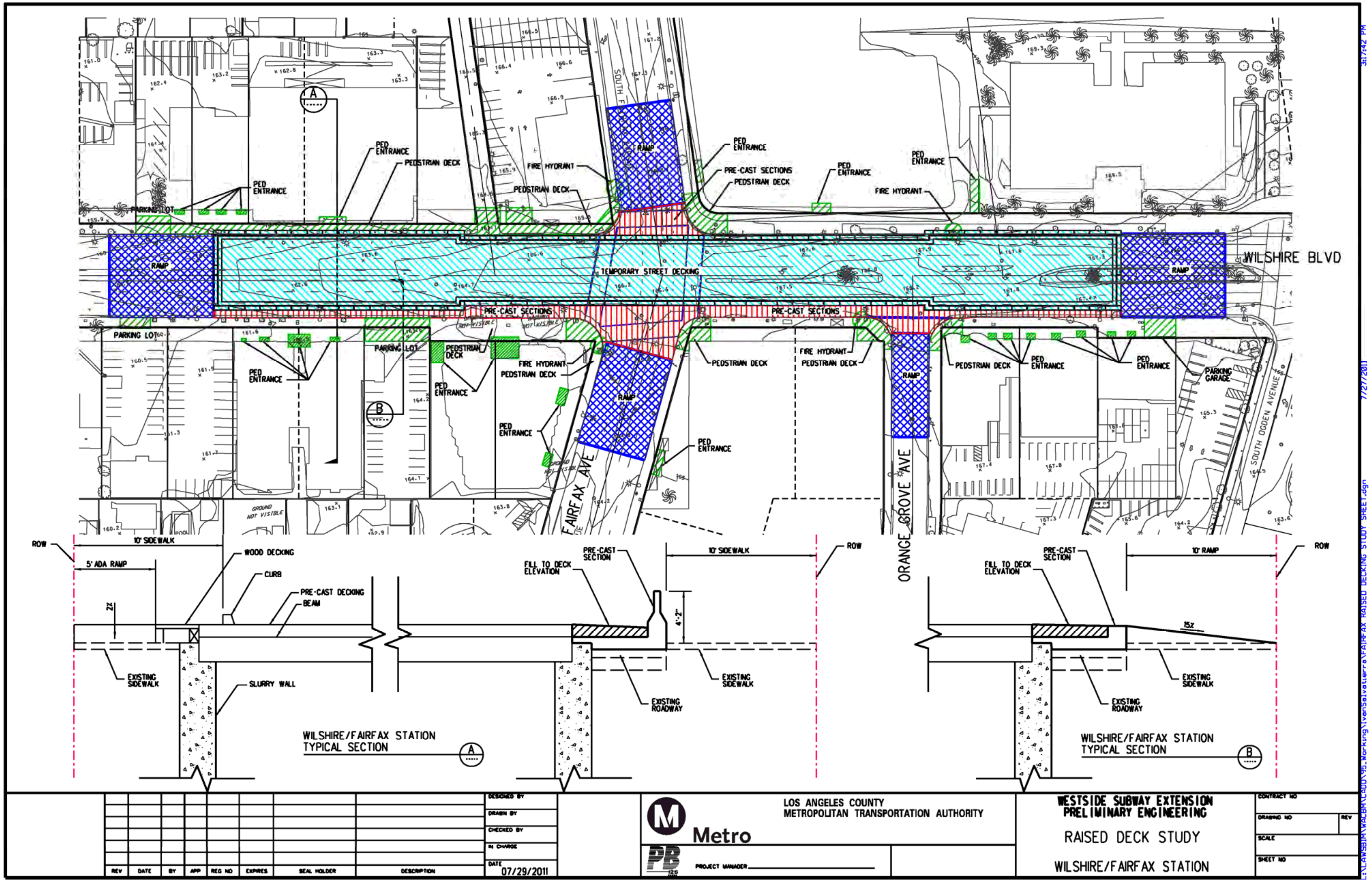
The project plans to use the same recovery methods that have been proven at Project 23, and with the cooperation of Page Museum staff, will seek to customize and improve on these methods to tailor them for the site conditions at Wilshire/Fairfax.

Further studies are on-going to find ways to raise the height of the beams used for street decking, which in turn, will leave more soil beneath the beams for controlled excavation and fossil recovery.

The fastest and lowest cost shoring method is preferred. This means that a soldier pile and lagging system will be employed provided that continuing geotechnical investigation do not find ground conditions that preclude this system. Soldier pile and lagging shoring has the added advantage of disturbing less of the station excavation footprint than other methods, minimizing the loss of fossils in this phase.

Gases will be controlled by installing adequate ventilation within the excavation, and by designing the street decking system with gaps for natural ventilation and elimination of pockets where gases could accumulate.

# APPENDIX A EXAMPLE OF RAISED DECKING




WESTSIDE SUBWAY EXTENSION PROJECT

Los Angeles County
Metropolitan Transportation
Authority
One Gateway Plaza
3rd Floor Board Room
Los Angeles, CA

Metro

# Board Report

**File #:** 2016-0101, **File Type:** Contract **Agenda Number:** 22

**CONSTRUCTION COMMITTEE**
**MAY 19, 2016**

**SUBJECT: PROGRAM CONTROL MANAGEMENT AND SUPPORT SERVICES**

**ACTION: EXERCISE CONTRACT OPTION AND AUTHORIZE ADDITIONAL CONTRACT VALUE IN AN AMOUNT NOT TO EXCEED $6,210,946**

## RECOMMENDATION

AUTHORIZE the Chief Executive Officer to execute:

A. Modification No. 3 to Contract No. PS8610-2879, **with Hill International, Inc. for Program Control Management and Support Services**, to exercise the final one-year option thereby extending the period of performance from June 28, 2016 to June 28, 2017, and increase the total contract not-to-exceed amount $6,210,946 from $18,482,598 to $24,693,544; and

B. individual Contract Work Orders (CWOs) and Contract Modifications within the Board approved not-to-exceed contract value.

## ISSUE

On May 24, 2012, the Board authorized the Chief Executive Officer to award a five-year labor-contract to provide Program Control Management and Support Services (PCMS) to support Board adopted capital projects. The Board also authorized individual CWOs be executed for an amount not to exceed $16,071,824 plus a 15% ($2,410,774) contract modification authority of the contract award, for a total not to exceed $18,482,598.

Contract No. PS8610-2879 was executed on June 28, 2012 for a three-year base term plus two one-year options. Since contract inception, Hill International has been responsive in providing the PCMS services to support Metro projects. Primarily due to satisfactorily performance, the first one-year option was exercised, extending the period of performance through June 28, 2016, without any increase to the approved contract value.

Staff has issued CWOs and modifications totaling $17,407,044 to date. Staff is requesting an increase to continue PCMS required to support Metro adopted capital projects through the final option-year period. It has been determined that the previously negotiated rates for the final year with Hill International are fair, reasonable, and are competitive in the current market.

## DISCUSSION

The primary role of the PCMS is to provide skilled and qualified staff to perform project-level support activities include enhancing our capabilities in the areas of project controls for project cost and schedule management, cost estimating to establish project budgets and independent cost estimates for contract actions, and configuration management for facilitating document-management and change control requests.

Both Metro and the PMCS consultant staff, in most cases, work side-by-side in integrated project management offices (IPMO). The subject contract allows us to efficiently and effectively augment Metro Program Control staff as required to ensure proper resources needed to manage a project are available to us both in terms of staff availability and technical expertise.

The level of PCMS services are projected to increase significantly in the final one-year contract period. This increase is primarily due to adding support on three (3) major Transit Construction projects (Crenshaw/LAX, Regional Connector, Westside Purple Line Extension Section 1) that are now in full construction phase and to support additional projects, including Westside Purple Line Extension Section 3 Project, Emergency Security Operations Center Phase One Project, Division 20 Portal Widening and Turnback Facility Project, and Airport Metro Connector Project, etc. The contract increase is based on planned level of PCMS services, and the CWOs issued will reflect the actual level of PCMS services required to support the Board-approved projects.

The PCMS contract funds are authorized by issuing separate CWOs for various projects using labor classifications and rates set forth in the contract. This method of contracting results in more efficient cost and schedule management, since CWOs and modifications to existing CWOs are negotiated and issued as additional work is identified.

## DETERMINATION OF SAFETY IMPACT

This Board action will not have an impact on established safety standards for Metro's construction projects.

## FINANCIAL IMPACT

Funding for these services are included in the approved FY16 Budget for the various Metro projects. The individual CWOs will be funded from the associated life-of-project (LOP) budgets. The project managers and Executive Director, Program Management will be accountable for budgeting the remaining amount in FY17.

### Impact to Budget

There is no impact to the FY16 Budget as funds for this action are included in the approved budget for each project. These funds are not eligible for bus and rail operating purposes.

## ALTERNATIVES CONSIDERED

The Board may elect to discontinue using Hill International for PCMS services through FY17. Staff does not recommend this alternative as the capital projects the consultant are assigned to are in various degrees of completion and the loss of staff would cause these projects to be significantly impacted. Given that the contract with Hill International will expire in June 2017, staff will issue a new Request for Proposal (RFP) for Program Control Management and Support Services to ensure a new contractor is available before the existing contract expires.

We also considered providing the services through Metro in-house staff. This alternative will require the addition of significant Metro staff and additional time to recruit and hire new staff. This alternative is also not recommended since the intent of the PMCS is to augment Metro staff in terms of technical expertise and availability of personnel. PMCS services are typically required on a periodic or short-term basis to accommodate for peak workloads or specific tasks over the life of the projects. Further, for some projects, the specific technical expertise required may not be available within Metro staff resources, whereas the PMCS contractor can provide the technical expertise on an as-needed basis.

## NEXT STEPS

Staff will issue a contract modification and issue contract work orders, as needed. Also, staff will work with Vendor/Contract Management to issue a new RFP to re-solicit the Program Control Management and Support Services.

## ATTACHMENTS

Attachment A - Procurement Summary
Attachment B - Contract Work Order/Modification Log
Attachment C - DEOD Summary

Prepared by:

Brian Boudreau, Managing Executive Officer, Program Control (213) 922-2474

Reviewed by:

Ivan Page, Interim Executive Director, Vendor / Contract Management (213) 922-6386

Richard Clarke, Executive Director, Program Management (213) 922-7557

Phillip A. Washington
Chief Executive Officer

**ATTACHMENT A**

# PROCUREMENT SUMMARY

## PROGRAM CONTROL MANAGEMENT AND SUPPORT SERVICES / PS8610-2879

| | | | | |
|---|---|---|---|---|
| **1.** | **Contract Number**: PS8610-2879 | | | |
| **2.** | **Contractor**: Hill International, Inc. | | | |
| **3.** | **Mod. Work Description**: Exercise final one-year option and increase Contract Value for planned work orders/modifications to support Board approved projects. | | | |
| **4.** | **Work Description**: Project Control Management Support Services | | | |
| **5.** | **The following data is current as of**: April 22, 2016 | | | |
| **6.** | **Contract Completion Status**: | | **Financial Status**: | |
| | | | | |
| | **Award Date**: | 5/24/12 | **Board Approved NTE Amount**: | $16,071,824 |
| | **Notice to Proceed (NTP)**: | 6/28/12 | **Total Contract Modification Authority (CMA)**: | $2,410,774 |
| | **Original Completion Date**: | 6/28/16 | **Value of Task Orders and Mods. Issued to Date (including this action)**: | $24,693,544 |
| | **Current Est. Complete Date**: | 6/28/17 | **Remaining Board Approved Amount:** | $1,075,554 |
| | | | | |
| **7.** | **Contract Administrator:** Brian Mahaffey | | **Telephone Number:** (213) 922-7327 | |
| **8.** | **Project Director:** Brian Boudreau | | **Telephone Number:** (213) 922-2474 | |

## A. Contract Action Summary

This Board Action is to approve Contract Modification No. 3 to exercise the final one-year option and to increase the not-to-exceed contract value.

All Work Orders and Contract Modifications are handled in accordance with Metro's Acquisition Policy. The contract type is a negotiated labor-hour work order contract.

In May 2012, the Board authorized the CEO to award Program Control Management and Support Services to Hill International, Inc. and execute individual contract work orders within the Board approved not-to-exceed contract value $16,071,824, plus a contract modification authority of $2,410,774 (15% of contract value). In June 2012, Contract No. PS8610-2879 was awarded for a five-year contract term, inclusive of two one-year options to be exercised at the sole discretion of the Authority.

Since contract award, Hill International has performed satisfactorily providing Program Control Management and Support Services on various Metro projects. In June 2015, the first one-year option was exercised to extend the period of performance to June 28, 2016 without any increase to the contract value.

This current recommended action is to:

- Exercise the final contract option year, extending the period of performance from June 28, 2016 to June 28, 2017; and
- Increase the not-to-exceed contract value for contract work orders and modifications required to continue Program Control Management and Support Services through the final one-year option period.

Attachment B shows contract work orders and modifications issued to date, and the additional contract work orders and modifications that are currently planned for the final one-year option period. The actual contract work order and modifications will reflect the PCMS required to support the Board approved projects.

## B. Cost/Price Analysis

The price for all future contract work orders and modifications will be determined to be fair and reasonable in accord with Metro's Procurement Policies and Procedures and based on audit by Management Audit Services of the direct labor and annual provisional overhead rates. A cost analysis, technical evaluation, fact finding, and negotiations will be performed on all work orders and any Contract Modifications. It has been determined that the previously negotiated rates for the final year with Hill International are fair, reasonable, and are competitive in the current market.

**ATTACHMENT B**

## CONTRACT WORK ORDER / MODIFICATION LOG

## PROGRAM CONTROL MANAGEMENT & SUPPORT SERVICES CONTRACT / PS8610-2879

| CWO/ Mod | Description | Status | Date | Cost |
|---|---|---|---|---|
| 1 | Program Control Management Assistance | Approved | 7/20/12 | $448,715 |
| 2 | Project Management Information System (PMIS) | Approved | 9/11/12 | $615,682 |
| 3 | Division 13 Document Control Specialist | Approved | 7/27/12 | $774,310 |
| 4 | Life Cycle Cost Analysis | Approved | 9/6/12 | $88,613 |
| 5,<br>26-27,<br>28,<br>30,<br>31-32,<br>55<br>56 | Highway Program Project Control Support | Approved | 10/16/12<br>7/10/13<br>7/11/13<br>8/28/13<br>9/4/13<br>6/18/14 | $1,189,275 |
| 6 | Rail Car Rehabilitation Support Services | Approved | 11/6/12 | $59,239 |
| 7 | Southwestern Yard Maintenance (SWY) Cost Estimating Support | Approved | 1/15/13 | $261,916 |
| 8 | PMIS Highway Support Services | Approved | 11/28/12 | $359,956 |
| 9 | ARTI Document Management Support | Approved | 5/22/13 | $37,987 |
| 10 | TIGER Grant | Approved | 6/6/13 | $4,995 |
| 11 | Universal Bridge Project Control | Approved | 1/17/13 | $161,302 |
| 12,<br>20-25,<br>37,<br>77 | Estimating Support and Project Cost Support on Environmental Program | Approved | 11/14/12<br>7/1/13<br>12/6/13<br>7/7/15 | $1,546,077 |
| 13 | Division 13 Project Control Support | Approved | 11/14/12 | $122,245 |
| 14 | I-405 Sepulveda Pass Project Control Support | Approved | 1/23/13 | $93,247 |
| 15 | Universal City Bridge Estimating Services | Approved | 2/6/13 | $51,135 |
| 16 | Blue Line Refurbish Estimating Services | Approved | 3/28/13 | $34,182 |
| 17 | Regional Connector Estimating Services | Approved | 3/28/13 | $1,438,089 |
| 18 | Westside Purple Line Extension (PLE) Section 1 Estimating Services | Approved | 4/16/13 | $2,014,086 |
| 19 | Management Succession Planning - Rail Transit | Approved | 8/8/13 | $11,195 |
| 33 | Change Management Custom Application | Approved | 9/25/13 | $226,914 |
| 34 | Measure R Cost Estimate Review Services | Approved | 9/26/13 | $117,942 |
| 35 | Project Management Academy Training | Approved | 11/21/13 | $271,690 |
| 36 | PMIS Application | Approved | 11/26/13 | $2,134 |
| 38 | Project Control for MRL/MOL N. Hollywood | Approved | 1/30/14 | $165,915 |
| 39 | PMIS Expenditure Data Services | Approved | 12/19/13 | $43,997 |
| 40 | Crenshaw/LAX Cost Estimating Support | Approved | 12/18/13 | $1,334,309 |
| 41 | MRL/MOL N. Hollywood Station Document | Approved | 2/5/14 | $211,581 |

| CWO/ Mod | Description | Status | Date | Cost |
|---|---|---|---|---|
| 42 | Universal City Pedestrian Bridge Document | Approved | 2/5/14 | $211,581 |
| 43 | EcoSys Project Control Technical Support | Approved | 2/5/14 | $235,220 |
| 44 | PMIS CMI Screen Modification Support | Approved | 2/5/14 | $7,500 |
| 45 | Southwestern Yard Project Control Support | Approved | 3/5/14 | $32,680 |
| 46-47 | Highway Document Control | Approved | 5/13/14 | $1,415 |
| 48 | Patsaouras Plaza Document Control | Approved | 5/7/14 | $214,850 |
| 49 | PMIS Cost Engineering Support | Approved | 3/13/14 | $130,901 |
| 50 | Blue Line Refurbishment Document Control | Approved | 11/14/14 | $188,082 |
| 51<br>52<br>53<br>54 | ARTI Cost Estimating | Approved | 4/23/14<br>4/24/14<br>4/25/14<br>4/23/14 | $141,951 |
| 57 | Westside PLE Section 2 Estimating Support | Approved | 7/22/14 | $238,233 |
| 58 | Ongoing PMIS Software Support | Approved | 8/14/14 | $444,135 |
| 59 | Regional Connector Project Control Support | Approved | 9/18/14 | $1,453,896 |
| 60 | PMIS Issue Module | Approved | 9/4/14 | $13,457 |
| 61 | PMIS CM14 Migration | Approved | 10/13/14 | $179,677 |
| 62 | Security PMO Plan | Approved | 8/27/14 | $50,964 |
| 63 | Organization Assessment for Risk | Approved | 12/5/14 | $88,020 |
| 64 | WPLE 1 Cost Schedule Support | Approved | 9/5/14 | $494,304 |
| 65 | I-405 Cost Estimating Support | Approved | 10/31/14 | $67,052 |
| 66 | Potential New Tax Initiatives Estimate Support | Approved | 2/11/15 | $99,919 |
| 67-69, | Rail Operation Capital Project Control Support | Approved | 12/5/14 | $258,990 |
| 74 | Pershing Square Escalator Replacement Project Scheduling | Approved | 6/29/15 | $37,810 |
| 76 | PMIS Work Order Processing | Approved | 4/16/15 | $200,773 |
| 78-79 | Highway Program Project Control Support | Approved | 7/9/15 | $347,672 |
| 80 | Rail Operations Sharepoint Development | Approved | 8/31/15 | $61,005 |
| 81 | MBL Pedestrian & Swing Gates Installation Project Control Services | Approved | 9/18/15 | $38,545 |
| 82 | Estimating Support on Accommodations of Future Metro Airport Station | Approved | 10/1/15 | $31,236 |
| 83 | Westside PLE Section 2 Project Control Support Services | Approved | 12/1/15 | $219,811 |
| 84 | Major Rail Project Risk Register Prototype Implementation | Approved | 11/5/15 | $59,496 |
| 90 | Southwestern Maintenance Yard Project Control Support Services | Approved | 4/6/16 | $171,142 |
| | **CWO/Modification Total:** | | | **$17,407,044** |
| | **Board Authorized NTE & CMA:** | | | **$18,482,598** |
| | **Remaining Contract Modification Authority:** | | | **$1,075,554** |

| CWO/ Mod | Description | Status | Cost |
|---|---|---|---|
| 1 | Program Control Management Assistance (100800) | Planned | $99,400 |
| 11 | Universal City Pedestrian Bridge Project Control (809382) | Planned | $17,300 |
| 17 | Regional Connector Estimating (860228) | Planned | $377,000 |
| 18 | Westside Purple Line Extension (WPLE) 1 Estimating (865518) | Planned | $1,090,000 |
| 38 | MRL/MOL N. Hollywood Station Project Control (204122) | Planned | $22,300 |
| 40 | Crenshaw Estimating (865512) | Planned | $800,000 |
| 41 | MRL/MOL North Hollywood Station Document Control (204122) | Planned | $46,000 |
| 42 | Universal City Pedestrian Bridge Document Control (809382) | Planned | $3,000 |
| 43 | Ecosys Project Control Technical Support (100800) | Planned | $140,000 |
| 48 | Patsaouras Plaza Document Control (202317) | Planned | $135,700 |
| 57 | WPLE 2 Estimating (865522) | Planned | $334,000 |
| 58 | Ongoing PMIS Software Support (100800) | Planned | $270,200 |
| 59 | Regional Connector Project Control (860228) | Planned | $418,000 |
| 64 | WPLE 1 Project Control (865518) | Planned | $186,800 |
| 7 | SWY Estimating (860003) | Planned | $314,000 |
| 74 | Pershing Square Escalator Replacement ( 204133) | Planned | $28,600 |
| 77 | Project Control & Estimating to Environmental (202211/300012/450001/450002/450003/450004) | Planned | $584,000 |
| 78-79 | Highway Program Project Control (100055/405522) | Planned | $438,000 |
| 81 | MBL Pedestrian & Swing Gates Installation Project Control Services (205104) | Planned | $29,000 |
| 83 | WPLE 2 Project Scheduling (865522) | Planned | $382,000 |
| 90 | Southwestern Maintenance Yard Project Control (860003) | Planned | $457,000 |
| TBD | Crenshaw Project Control (865512) | Planned | $166,000 |
| TBD | Various Operations Capital Projects (205066/205055/205056/205092/205078/205070/205097/ 211013/204128/211029/205099/205058/205067/205072/ 205079/205083/211030/205102/205040/205093/205101/ 205038/205087/204123/205088/204135/205103/800113) | Planned | $190,200 |
| TBD | 96th Street Future Airport Connector (860303) | Planned | $152,000 |
| TBD | Division 20 Turnback Portal Widening (TBD) | Planned | $152,000 |
| TBD | Emergency Security Operations Center Project Control Support Services (212121) | Planned | $28,000 |
| TBD | WPLE 3 Estimating (865523) | Planned | $152,000 |
| TBD | WPLE 3 Project Control (865523) | Planned | $274,000 |
| | **FY17 Planned CWO/Modification Total:** | | **$7,286,500** |
| | **Remaining Contract Modification Authority:** | | **$1,075,554** |
| | **Additional Contract Authority Increase Request:** | | **$6,210,946** |

# DEOD SUMMARY

## PROGRAM CONTROL MANAGEMENT AND SUPPORT SERVICES / PS8610-2879

## A. Small Business Participation

Hill International made a 20% Disadvantaged Business Enterprise (DBE) commitment. Current DBE participation is 17.80%, a shortfall of 2.20%. This project is 75% complete. According to Hill International, and confirmed by Metro's Project Management, Hill was required to augment its team to provide strong Oracle expertise by adding non-DBE subcontractors, DRMcNatty and EcoSys to perform on-going project management information system (PMIS) services required by the contract scope. Cambria Solutions, a certified DBE, was added to perform policy and organization assessment related work.

Based on the current authorized contract value, Hill International has projected that they will exceed their DBE commitment (21%).

| **Small Business Commitment** | **20% DBE** | **Small Business Participation** | **17.80% DBE** |
|---|---|---|---|

| | **DBE Subcontractors** | **Ethnicity** | **% Committed** | **Current Participation[1]** |
|---|---|---|---|---|
| 1. | LS Gallegos | Hispanic American | 7.93% | 6.13% |
| 2. | LKG CMC | Caucasian Female | 6.35% | 10.03% |
| 3. | Stellar Services | Asian Pacific American | 5.72% | 0.82% |
| 4. | Cambria Solutions | Hispanic American | Added | 0.82% |
| | | **Total** | **20.00%** | **17.80%** |

[1]*Current Participation = Total Actual amount Paid-to-Date to DBE firms ÷Total Actual Amount Paid-to-date to Prime.*

## B. Living Wage and Service Contract Worker Retention Policy Applicability

The Living Wage and Service Contract Worker Retention Policy is not applicable to this contract.

## C. Prevailing Wage Applicability

Prevailing wage is not applicable to this contract.

## D. Project Labor Agreement/Construction Careers Policy

Project Labor Agreement/Construction Careers Policy is not applicable to this contract.

Los Angeles County
Metropolitan Transportation
Authority
One Gateway Plaza
3rd Floor Board Room
Los Angeles, CA

**File #:** 2016-0250, **File Type:** Contract **Agenda Number:** 36.

**REVISED**
**CONSTRUCTION COMMITTEE**
**MAY 19, 2016**

**SUBJECT: METRO GOLD LINE INTERSTATE 210 BARRIER REPLACEMENT**

**ACTION: APPROVE RECOMMENDATION**

## RECOMMENDATION

AUTHORIZE the Chief Executive Officer (CEO) to:

A. ADOPT a Design Life of Project Budget for $11,078,366 for the **I-210 Barrier Replacement Project to develop a Risk Assessment Study, Environmental Clearance and Final Design documents** for future construction consideration;

B. AMEND FY16 Budget by $553,918 and AMEND FY17 Proposed budget by $9,970,529 to fund aforementioned efforts;

C. AWARD AND EXECUTE a fourteen-month labor hour Task Order No. 12 for Contract No. PS4730-3070. Highway Programs on-call support services, to CH2M Hill Inc. in an amount not-to-exceed $4,799,967 for Architectural and Engineering (A&E) services for the preparation of the Project Report and Environmental Documents (Categorical Exemption) and the Plans, Specifications and Estimates for the Metro Gold Line Interstate 210 Barrier Replacement; and

D. EXECUTE Modification No.1 to Contract No. PS4730-3070 to increase the not-to exceed value by $4,799,967 from $10,000,000 to $14,799,967.

## ISSUE

Since the opening of the Metro Gold Line, there have been six accidents in which a big rig vehicle, traveling on the 210 Freeway, has entered into the operating Right-of-Way. The latest incident occurred on Sunday, March 6, 2016. During the incident, the tractor caught fire causing damage to the Gold Line system and a major disruption. The Gold Line required immediate repairs which were not complete until early the following morning. Staff proposes to develop design options for barrier improvements for the Pasadena Gold Line and effectively mitigate the risks of future breaches into Metro's Gold Line Right-of-Way. Once the barrier improvements have been approved by Caltrans, Metro will procure a construction contract for installation of the improvements.

## DISCUSSION

We have provided the Board with two board boxes on this critical safety issue on May 7, 2014 and again on December 3, 2015. In these board boxes, we explained that Metro staff determined the need to proceed with the replacement of the existing barriers and have been working on developing a plan to do so. We explained that Metro Engineers have investigated the various barrier alternatives available which meet Caltrans standards and for which installation will have minimal effect on our
Right-of-Way, and will be sturdy and tall enough to reduce the risk of vehicles breaching the median barrier and colliding with one of our trains or injure Metro patrons on station platforms. We have had several meetings with Caltrans to discuss this issue and to share our findings. Metro Engineering's preliminary view is that there is a need to replace the existing 32" high Type 50 barriers (which do not provide adequate protection) with a taller 56" high, Type 60 G Caltrans barrier. This improved barrier will provide the highest available level of crash test worthiness, TL 5 or Test Level 5 that is currently available and in-use, and will bring the Interstate 210 corridor in line with similar Caltrans improvements already implemented as part of the Interstate 710 center median.

The study and design for which we are seeking Board approval, includes preparation of a Project Report (PR) which will either validate the barrier Type 60 G as appropriate for our needs, or recommend an alternate Caltrans Standard barrier(s) which might better fit our needs.

It should be noted that we have reviewed the possibility of using taller barriers than the Caltrans Type 60 G, and found such an approach to be incompatible with the existing conditions as the existing bridges were not designed to carry such a larger load. Also, when the contractor finally replaces the barriers on the existing bridges, some minor strengthening of the existing girders may be needed. Therefore, staff believes that the final design must limit the amount of additional load added to the bridge to avoid triggering seismic retrofits. Additionally, using barriers taller than 56" may result in reduced sight distance for the drivers on the freeway and require reconfiguration of the freeway lanes to bring sight distance to required code limits; potentially a costly addition to the project's cost.

We are asking the Board to authorize the necessary funding to allow Metro staff to enter into contracts to complete the first phase of the project, which is to prepare a risk assessment study under a separate contract to be issued, while concurrently obtaining environmental clearance (Categorical Exemption) under the recommended Task Order. The second stage of the project will be to develop the final design and a construction cost estimate. The final stage of the project will be to solicit a separate construction contract to install the improvements.

Risk Assessment Study:

Funding will be used to hire a consultant to prepare a risk assessment study, with the objective of developing a plan for protecting the Gold Line from the same kind of accidents that have occurred thus far along the I-210 freeway. The objective is to assess the risks associated with each type of accident, their particular locations and their impacts on the operation of the Gold Line. Impacts of accidents include such things as loss of life, property damage, and short and long-term service disruptions.

New Barriers - Environmental Clearance (Categorical Exemption) Final Design and Construction Cost Estimate

Metro Engineers have prepared two options for the replacement of the existing barrier. The first option (minimal approach) is a partial barrier replacement which would provide only the minimum level of enhanced crash barriers adjacent to stations locations and designated critical equipment (train control cases and bungalows) along the east and west bound directions of the alignment. The second option (full approach) would replace the full 12 miles of barriers in both east and west bound directions.

In the interest of time it was decided that during the development of the risk assessment study, the design for the whole 12 miles (full approach) will be developed and adjusted as a result of the findings and recommendations of the risk assessment study to refine the design at appropriate locations. Upon completion of the final design, it will be included in the solicitation package which will be prepared to bid the job.

Intrusion Detection System

Metro Engineers will evaluate the feasibility of using an intrusion detector which would be installed on the top of the new barriers system; when the intrusion detection system is activated, the signal will serve to stop all trains in the vicinity, thus reducing the probability that a train may be hit by a vehicle breaching into our Right-of-Way. If the solution appears feasible and the level of potential false alarms of this sensitive system is low enough to be acceptable, we will proceed with developing the design of this system and will coordinate the interfaces between the installation of the system and the new barriers systems.

Task Order No. 12 Work and Caltrans Participation

In order to be responsive to this high priority and urgent project, we elected to use the Metro On-Call project management and quality assurance/control support services Contract No. PS4730-3070 with CH2M Hill Inc. (CH2M). CH2M has the experience on this type of work and has committed to prepare this Phase 1 effort within the required timeframe.

CH2M will use Metro's Preliminary Engineering Package as a starting point to develop a Final Design package (plans, specifications and estimates) for the barriers replacement. CH2M's proposal also includes constructability reviews of their design with the objective of ensuring that their design will minimize the number and types of disruptions to Gold Line Operations during construction. In addition, the risk assessment study results will help determine with more accuracy whether or not there is a need to replace all of the existing barriers along the entire 12 miles alignment (full approach) or only at selected sections of the alignment. CH2M will also develop a more definitive construction cost estimate and Metro staff will come back to the Board in early FY18 with a request to approve funds for Phase 2, construction of the project.

Metro staff met with Caltrans several times in the last year to share their approach and seek a consensus with this important partner for this project. As recently as April 14, 2016 we met with Caltrans executives and sought their comments on CH2M's scope of services, which were then incorporated by CH2M in a revised scope of work. Caltrans' specific request was to increase the number of Alternatives in the Project Report from one to three, to expand the mapping limits of the project, and to add Landscape Architecture services to the scope; which were all incorporated into the revised scope of work. This coordination process culminated in a three way meeting on April 19, 2016 between Metro, Caltrans and CH2M to make sure there was a consensus on the resulting scope for CH2M and on the role of each partner for this project.

In addition Caltrans has made us aware of their plan to design and build an Active Traffic Management (ATM) System on the I-210. This ATM system consists of signs placed above each lane of the freeway, approximately every half a mile and displaying the maximum speed allowed on each lane: Metro agreed that the design work by CH2M for Metro I-210 project will provide for future installation by Caltrans of this ATM equipment. In other words, based on inputs to be provided timely by Caltrans to Metro, CH2M will ensure their design of Metro I-210 project can accommodate Caltrans ATM facilities such as pylons, ductbanks and conduits to be installed by Caltrans at a later stage.

Finally, ~~Further,~~ we have also secured direct participation of Caltrans to support ~~the~~ Metro I-210 barriers replacement project, review the work of CH2M and issue the permit at the end of Phase 1 through the issuance of a work order under the existing Master Cooperative Agreement for $1,815,306.

Phased Construction

Considering the concurrence of activities of this complex project with a risk assessment study prepared while we develop final design and estimate, it is the intention of staff to develop a strategy to be submitted to the board approval at the end of this design phase, which will discuss a potential phased construction approach. Depending on the results of the risk assessment study and of the project report staff might propose to install these new barriers in a phased way: First phase would very likely covers the stations areas where we have large number of patrons, a second phase would be in areas where sensitive equipment such as signaling bungalows are located, a third phase would include sections of the freeway with a tight radius curves, etc. Staff might also recommend to install the new barriers system for the entire affected 6 miles alignment.

## DETERMINATION OF SAFETY IMPACT

This Board's decision to approve this Project is paramount to ensuring public safety along the Metro Gold Line I-210 corridor.

Implementation of this project will be an important step in improving safety and to reduce the likelihood of future breaches into Metro's Gold Line Operational Right-of- Way. The improvements described in this project are necessary for public safety.

## FINANCIAL IMPACT

Upon approval of the recommendations, staff will establish a project number and a Life of Project budget for $ 11,078,366 to execute the final design and supplementary requirements as described. Final design budget will be programmed in the FY16, FY17 and FY18 budgets as per Attachment A, Sources and Uses Table. A majority of the budget will reside under cost center 8510 - Construction Procurement, Account number 50316 - Professional and Technical Services.

Since this will likely be a multi-year project, the Project Manager, Cost Center manager, and Executive Director of Program Management will be responsible for budgeting the cost in future fiscal years.

Impact to Bus and Rail Operation or Capital Budgets

The FY16, FY17 and FY18 budget amendments for this action will come from Proposition C 25% (PC25%) as a result of the workscope aligned with Highway related improvements. This fund source is not eligible for Bus or Rail Operations. No other fund source was considered.

## ALTERNATIVES CONSIDERED

The Board could choose not to approve this project. However, Metro staff believe that it is necessary to study alternatives to the existing form of barrier that exists along the 210 Freeway corridor through which the Gold Line operates, to reduce the risk of future vehicle intrusions into the Metro Gold Line I-210 median operating area.

## NEXT STEPS

Upon Board approval, Metro staff will hire a consultant to prepare a risk assessment study to determine the appropriate level of improvements to the existing barrier, issue Task Order No. 12 to CH2M, and issue a Work Order to Caltrans to coordinate the work, review and approve the work of CH2M.

## ATTACHMENTS

Attachment A - Design Life of Project Cost Estimate
Attachment B - Procurement Summary
Attachment C - Task Order Log
Attachment D - DEOD Summary

Prepared by:
Craig Remley, Sr. Structural Engineer (213) 922-.3981

Sam Mayman, Executive Officer, Engineering (213) 922-7289

Reviewed by:

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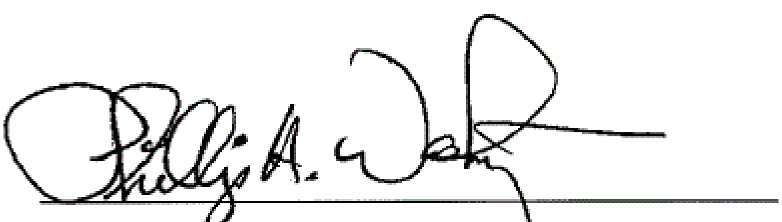
Greg Kildare, Executive Director, Risk, Safety and Asset Management (213) 922-4971

Jim Gallagher, Chief Operations Officer213) 922-4424

Richard Clarke, Executive Director of Program Management (213) 922-7557



Phillip A. Washington
Chief Executive Officer

ATTACHMENT A

## DESIGN LIFE OF PROJECT COST ESTIMATE

## METRO GOLD LINE INTERSTATE I-210 MEDIAN BARRIER REPLACEMENT

| **Use of Funds** (in dollars) | **FY16** | **FY17** | **FY18** | **Total Cost** | **%** |
|---|---|---|---|---|---|
| **Professional Services** | | | | | |
| Final Design Consultant | 239,998 | 4,319,970 | 239,998 | 4,799,967 | 43% |
| Risk Assessment Serivces | 50,000 | 900,000 | 50,000 | 1,000,000 | 9% |
| 3rd Party Reviews / Coord (CalTrans) | 90,765 | 1,633,775 | 90,765 | 1,815,306 | 16% |
| Design Intrusion Detection system | 5,000 | 90,000 | 5,000 | 100,000 | 1% |
| CMA | 38,576 | 694,375 | 38,576 | 771,527 | 7% |
| **Total Professional Services** | **424,340** | **7,638,120** | **424,340** | **8,486,800** | **77%** |
| | | | | | |
| **Metro Engineering & Admin** | **72,138** | **1,298,480** | **72,138** | **1,442,756** | **13%** |
| | | | | | |
| **Contingency** | **57,440** | **1,033,929** | **57,440** | **1,148,810** | **10%** |
| **Uses Grand total:** | **553,918** | **9,970,529** | **553,918** | **11,078,366** | **100%** |

| **Sources of Funds** (in dollars) | | | | | |
|---|---|---|---|---|---|
| Proposition C 25% Debt | **553,918** | **9,970,529** | **553,918** | **11,078,366** | 100% |

**ATTACHMENT C**

# TASK ORDER LOG

## HIGHWAY PROGRAM PROJECT MANAGEMENT AND QUALITY ASSURANCE/CONTROL SUPPORT SERVICES/PS4730-3070

| Task Order No. | Description | Date | Amount |
|---|---|---|---|
| 1 | Assistant Project Management and Engineering Support Services | 05/12/14 | $221,864 |
| 2 | Cancelled by Metro | | $0 |
| 3 | State Route 138 Capacity Enhancements Project Management Support | 05/13/14 | $50,476 |
| 4 | Risk Management Services for Interstate Route 5 (I-5) | 07/15/14 | $270,972 |
| 5 | SR-710 North Study Technical Support Services for Outreach | 07/03/14 | $385,992 |
| 6 | Update the Design of Soundwall Package No. 11 | 07/24/14 | $1,053,453 |
| 7 | Cancelled by Metro | | $0 |
| 8 | Potholing, Utility Coordination, Right-of-Way, Permitting & Environmental Documentation, | 08/27/15 | $371,405 |
| 9 | Project Resourcing and Schedule Management (PRSM) Services | 08/19/15 | $332,119 |
| 10 | Address City of Los Angeles Requirements | 01/19/16 | $489,964 |
| 11 | Cost Estimating Services for Potential Projects | 12/30/15 | $24,300 |
| 12 | Preparation of the Project Report and Environmental Documents (Categorical Exemption) and the Plans, Specifications and Estimates for the Metro Gold Line Interstate 210 Barrier Replacement. | **PENDING** | $4,799,967 |
| | **Task Order Total:** | | **$8,000,512** |
| | **Remaining Board Approved Amount:** | | **$1,999,488** |
| | **Original Contract NTE Amount:** | | **$10,000,000** |
| **Mod. No. 1** | **Increase NTE Contract Amount:** | **PENDING** | **$4,799,967** |
| | **Total Contract NTE Amount:** | | **$14,799,967** |

# DEOD SUMMARY

# PROJECT MANAGEMENT AND QUALITY ASSURANCE QUALITY CONTROL SUPPORT SERVICES FOR LA COUNTY/PS-4730-3070

## A. Small Business Participation

CH2M Hill made a 31% Small Business Enterprise (SBE) commitment. CH2M Hill's current SBE participation is 13.12%, representing a 17.88% shortfall. The contract is for on-call support services. SBE participation is based on the aggregate value of all task orders issued. To date 11 task orders have been issued and the overall contract is currently 64% complete. SBE firms were utilized on 6 task orders, 3 task orders had zero SBE participation, and 2 task orders were cancelled.

In response to the shortfall, CH2M explained, and Metro's Project Manager confirmed, that Task Order No. 3 (Project Management Support Services) had no SBE subcontract opportunities, because the task order required the qualifications of one individual to assist Metro's Project Manager; and there were no SBE subcontract opportunities on Task Order No. 4, because Caltrans requested that they (CH2M) perform the scope of work with their own workforce. Metro's Project Manager confirmed that CH2M continues to identify opportunities for SBE participation on Task Order No. 9, which is approximately 10% complete. CH2M made a 42.67% SBE commitment on Task Order No. 12, which is pending award, and confirmed that their overall SBE participation will increase to 32.67%.

| | | | |
|---|---|---|---|
| **Small Business Commitment** | **31% SBE** | **Small Business Participation** | **13.12% SBE** |

| | SBE Subcontractors | % Commitment | Current Participation[1] |
|---|---|---|---|
| 1. | Arellano Associates | 2.00% | 0.04% |
| 2. | AFSHA, Inc. | 1.00% | 0.00% |
| 3. | Barrio Planners, Inc. | 3.00% | 7.21% |
| 4. | Epic Land Solutions, Inc. | 4.00% | 0.00% |
| 5. | Galvin Preservation Associates | 5.00% | 0.00% |
| 6. | JM Diaz | 7.00% | 5.25% |
| 7. | MARRS Services | 7.00% | 0.00% |
| 8. | Wagner Engineering and Survey, Inc. | 2.00% | 0.62% |
| | **Total SBE Commitment** | **31.00%** | **13.12%** |

[1] *Current Participation = Total Actual amount Paid-to-Date to SBE firms ÷Total Actual Amount Paid-to-date to Prime.*

## B. Prevailing Wage Applicability

Prevailing wage is not applicable to this contract.

**C. <u>Living Wage Service Contract Worker Retention Policy</u>**

The Living Wage and Service Contract Worker Retention Policy is not applicable to this contract.

**D. <u>Project Labor Agreement/Construction Careers Policy</u>**

Project Labor Agreement/Construction Careers Policy is not applicable to this contract.

**ATTACHMENT B**

# PROCUREMENT SUMMARY

## HIGHWAY PROGRAM PROJECT MANAGEMENT AND QUALITY ASSURANCE/CONTROL SUPPORT SERVICES/PS4730-3070

| | | | | |
|---|---|---|---|---|
| **1.** | **Contract Number**: PS4730-3070: Task Orders No. 1 to 12 | | | |
| **2.** | **Contractor**: CH2M Hill Inc. | | | |
| **3.** | **Task Order Work Description**: Task No. 12 – Preparation of the Project Report and Environmental Documents (Categorical Exemption) and the Plans, Specifications and Estimates for the Metro Gold Line Interstate 210 Barrier Replacement. | | | |
| **4.** | **Work Description**: Professional engineering services. | | | |
| **5.** | **The following data is current as of**: 05/06/16 | | | |
| **6.** | **Contract Completion Status**: | | **Financial Status**: | |
| | | | **Original Contract Funding NTE Amount:** | **$10,000,000** |
| | **Contract Award Date**: | **12/5/13** | **Pending Task Order Award Amount**: | **$4,799,967** |
| | | | **Total Task Orders Approved**: | **$3,200,545** |
| | **Original Completion Date**: | **01/03/17** | **Value of Task Orders Issued to Date (including this action)**: | **$8,000,512** |
| | **Current Est. Complete Date**: | **01/03/17** | **Remaining Board Approved Amount**: | **$1,999,488** |
| | | | | |
| **7.** | **Contract Administrator**: **Erika Estrada** | | **Telephone Number**: **(213) 922-1102** | |
| **8.** | **Project Manager**: **Benkin Jong** | | **Telephone Number**: **(213) 922-3053** | |

## A. <u>Procurement Background</u>

This Board Action is to award Task Order No. 12 and increase the total not-to-exceed (NTE) value for Contract No. PS4730-3070 in the equivalent dollar amount to develop the Project Report (PR), prepare the Environmental Documents (ED) (Categorical Exemption), and prepare the Plans, Specifications and Cost Estimate (PS&E) for the Metro Gold Line Interstate 210 (I-210) Barrier Replacement.

The Task Order RFP was issued in accordance with Metro's Acquisition Policy and the contract type is a Labor-Hour Task Order per the original contract terms.

On December 5, 2013 the Metro Board approved and awarded Item 21, a Labor-Hour Task Order Contract No. PS4730-3070 for Highway Program Project Management and Quality Assurance/Control Support Services, to CH2M Hill Inc. for a three-year base period with two, one-year options, for an amount not-to-exceed $10,000,000. To date, 11 task orders have been issued in the amount of $3,200,545.

## B. Evaluation of Proposals/Bids

A Proposal Evaluation Team (PET) consisting of staff from Metro's Engineering Management, and Major Capital Project Engineering was convened and conducted a comprehensive technical evaluation of the proposal received for Task Order No. 12.

**Qualifications Summary of Recommended Firm:**

CH2M Hill Inc. (CH2) has extensive experience in all phases of the highway planning and project development process.  The firm has planned, designed and constructed numerous highway projects including some complex, high-priority transportation projects in Southern California for Metro, Caltrans, City of Los Angeles, Orange County Transportation Authority and local counties and municipalities.  The proposed CH2 team has a readily accessible pool of personnel resources, trained in a variety of disciplines that have full life-cycle transportation experience and expertise.

CH2 has experience in providing the required PR, ED and PS&E expertise mandated for the Metro Gold Line I-210 barrier replacement project. The CH2 team mapped out a proven project delivery approach (previously provided PR, ED and sound-wall expertise) to execute the work effort required. Further, the proposed Project Manager has 33 years of experience in designing and managing highway projects, including interchange improvement, highway realignment, rehabilitation, grade separation, and widening projects from preliminary engineering to final design and support during construction.  CH2's strength is in their proposed management plan, strong personnel, project delivery techniques and a clear understanding of the statement of work.  CH2's performance has been satisfactory for the 11 task orders executed to date.

## C. Cost Analysis

The recommended, NTE price for Task Order No. 12 has been determined to be fair and reasonable based on the utilization of the existing contract's negotiated labor rates, cost analysis, an independent cost estimate, technical analysis, and fact finding.

The fully burdened rates for the labor classifications required for Contract No. PS4730-3070 were determined to be fair and reasonable based upon MAS audit findings, an independent cost estimate, cost analysis, technical analysis, fact finding, and negotiations.

| Proposer Name | Proposal Amount | Metro ICE | NTE amount |
|---|---|---|---|
| CH2M Hill Inc. | $4,799,967 | $4,825,027 | $4,799,967 |

## D. <u>Background on Recommended Contractor</u>

The recommended firm, CH2M Hill Inc. (CH2) headquartered in Colorado with 28,000 employees and a local office in Los Angeles, is a global leader in engineering, procurement, construction, operations and management for government, civil, industrial and energy clients. CH2 has been providing professional services to private and public agencies since 1946. The firm has experience with highway projects which includes the State Route 710 North Study Alternatives Analysis, PR and ED, I-710 South sound-walls and I-170 and I-405 sound-walls package 11, Caltrans District 7 project development on call contracts, Riverside County's State 79 realignment PR and ED, and program management for City of Los Angeles, 6th Street viaduct replacement. CH2 assembled a highly qualified team with expertise in transportation planning, design, financing, traffic, operations and management.