February 23, 2007

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Subject: Bowtie Remediation Options

Dear Hiro,

As a consultant to Freedman Tung and Bottomley (FTB), EIP was tasked with reviewing the current status of environmental contamination in the Tracy Bowtie area and advising what efforts might be required to clean the area in a manner that would support the larger Downtown Specific Plan. The following description provides an overview and summary to a number of hazardous materials investigations that have been conducted in the Tracy Bowtie area. The purpose of this compilation is to provide an understanding of the type and nature of environmental contamination and how this contamination affects future redevelopment and reuse of the area.

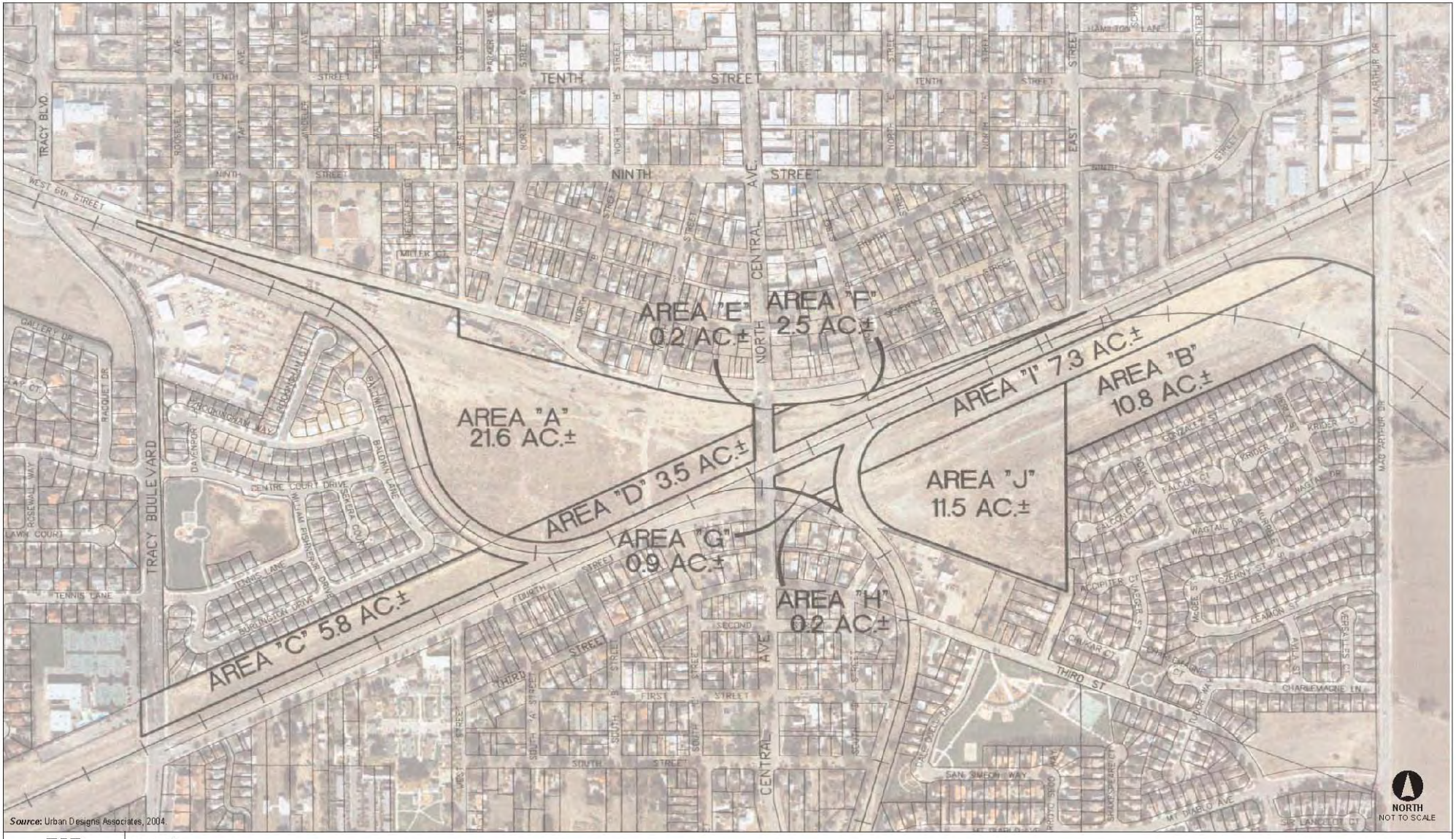
Study Area

The Bowtie area encompasses an area that is slightly larger than the former railyard that was operated by Southern Pacific Transportation Company. The railyard site is generally bounded by Sixth Street to the north, MacArthur Drive to the east, and Tracy Avenue to the west. The area referred to as the Bowtie includes the former railyard, plus the Congressional Land Grants and an additional sliver of land parallel to and south of Sixth Street and generally between North B Street and Roosevelt.

The Bowtie has been divided into 10 subareas for ease of discussion, Areas A through J as shown in Figure 1. As explained below, each area has slightly different histories and different levels of environmental contamination that affect clean-up, or remediation, strategies, and thus future land uses.

Historical Overview

Environmental contamination at any given site stems from two primary sources: activities on site and activities off site. In the Bowtie area, environmental contamination is primarily attributable to its former use as a maintenance facility for Southern Pacific Transportation Company. Following its active use for maintenance of Southern Pacific trains, the site was "decommissioned" in the 1940s and subsequently used as a rail welding facility. This activity continued until a majority of the structures and railroad tracks were removed in the 1980s. Following dismantling of the rail buildings, portions of the site have been used by American Transit Mix/RMC Lonestar (along MacArthur Drive) and warehousing businesses (around West Sixth Street). The site is vacant currently; however, these previous uses and activities contributed chemicals of concern that persist today. Contaminants from the railyard, underground tanks, and area pipelines have entered the soil and migrated into the underlying groundwater.



Source: Urban Designs Associates, 2004.

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FIGURE 1
Bowtie Sub Area Map

Table 1 summarizes the historical uses in each of the Bowtie subareas and the chemicals of concern that result from those activities. The chemicals of concern fall into several broad categories as outlined below:

- Lead, primarily from railroad tracks and pipelines.
- Arsenic, possibly from slag, a waste material from smelting, and wood treating processes.
- Total petroleum hydrocarbons, primarily from oil-filled sumps, oil sheds, equipment, and maintenance activities.
- Polynuclear aromatic hydrocarbons, chemical compounds that result from incomplete combustion of carbon-containing products such as fuels, wood, coal, and diesel.
- Volatile organic compounds, emitted as gases from a variety of sources including paints, lacquers, and fuels.
- BTEX (benzene, toluene, ethylbenzene, and xylenes), a group of volatile organic compounds found in petroleum derivatives; on-site BTEX contamination is likely the result of leaks from underground storage tanks containing petroleum products.

Significance of Environmental Contamination

Although chemicals of concern have been identified in the Bowtie area as result of past activities, the significance of this contamination depends on the desired uses proposed for the areas and the use-dependent public health thresholds applied by the regulatory agencies governing soil and groundwater contamination. This section summarizes the regulatory framework, the extent of investigation in each area, and the contaminants that need to be remediated in the Bowtie area.

Regulatory Framework. Various state and federal government agencies establish maximum allowable levels, or concentrations, of many chemical compounds to protect public health. The levels vary depending on whether the site will be used for residential uses or for commercial and industrial uses. The following thresholds were used to assess the Bowtie area:

- U.S. Environmental Protection Agency - Preliminary Remediation Goals (PRG)
- California Environmental Protection Agency - California Human Health Screening Levels (CHHSL)
- California Regional Water Quality Control Board - Environmental Screening Levels (ESL)
- California Department of Toxic Substances Control - a Remediation Goal established specifically for lead in Area B and the eastern half of Area I as the result of a previous effort to redevelop the site for residential uses.

The PRGs and CHHSLs are health-based risk guidelines that are used to determine if contaminant concentrations at a site may warrant remedial action to reduce exposure to certain contaminants.

Table 1
Environmental Contamination in the Bowtie

Subarea	Historical Railyard Use/Recognized Environmental Conditions	Chemicals of Concern
A	Railroad right-of-way and right-of-way maintenance, packing sheds, signal repair building, express building, yard master's office, warehouses, water pipelines, sewer pipelines, oil pipelines, slag ballast, and unidentified "purple colored material".	Lead Arsenic Total petroleum hydrocarbons Volatile organic compounds
B	Railroad tracks, wheel shops, locker rooms, planking, oiled macadam, rail beds, a coal house, refuse pit, various air and water pipelines, two underground storage tanks.	Lead Polynuclear aromatic hydrocarbons Volatile organic compounds and BTEX
C/D	Not investigated	Not investigated
E	See description of Area F	Total petroleum hydrocarbons Polynuclear aromatic hydrocarbons Volatile organic compounds and BTEX
F	Railroad ties and ballast, oil shed, oil-filled sumps, stockpiles of soil and debris, and petroleum pipeline.	Total petroleum hydrocarbons Polynuclear aromatic hydrocarbons Volatile organic compounds and BTEX
G	Railroad ties and ballast, petroleum pipelines	Lead Arsenic Total petroleum hydrocarbons Polynuclear aromatic hydrocarbons Volatile organic compounds and BTEX
H	See description for Area G	Lead Arsenic Total petroleum hydrocarbons Polynuclear aromatic hydrocarbons Volatile organic compounds and BTEX
I	For the western half of I, see description for Area J; for the eastern half of I, see description for Area B.	Lead Arsenic Metals Total petroleum hydrocarbons Polynuclear aromatic hydrocarbons Volatile organic compounds and BTEX
J	Primary industrial area of the railyard - former ponds filled with soil and concrete debris, an oil tank, an oil pump house, railroad tracks, various oil drains, oil pipes, air pipes, water pipes, settling tanks, pump houses, lumber shed, power house, a roundhouse area with one turntable, two roundhouse structures, an engine pit, oil sump, tool house, store house, railroad tracks, and associated oil pipes.	Lead Arsenic Metals Total petroleum hydrocarbons Volatile organic compounds

Local enforcement agencies such as the San Joaquin County Environmental Health Department may use the state thresholds over the federal ones. Exceedance of a threshold does not automatically require remedial action; each situation typically involves a site-specific remediation approach that takes into account human health risks and future land use proposals. This site-specific process recommends the desired clean-up levels and methods for remediation, and is negotiated with the appropriate regulatory agency. The Department of Toxic Substances Control generally assumes oversight responsibility if the contamination is primarily related to soils; the Regional Water Quality Control Board generally assumes oversight responsibility if the contamination is related primarily to groundwater.

Site Investigations and Chemicals Warranting Clean-Up. In characterizing a site, the regulatory agencies require a sampling plan and a justification why that plan should adequately identify the nature and extent of contamination on site. Submittal of initial results may trigger requests for additional sampling to better characterize the contamination. Except for Areas C and D, there has been a considerable history of investigation and sampling at each of the areas. The sampling plans for past investigations were developed based on the location of past uses and activities (i.e., the recognized environmental conditions that could have resulted in leaks or spills of hazardous materials).

On June 23, 2005, Union Pacific, the current owners of the former railyard, elected to participate in the state's Voluntary Clean-up Program. Under the oversight of the Department of Toxic Substances Control, Union Pacific entered an agreement to:

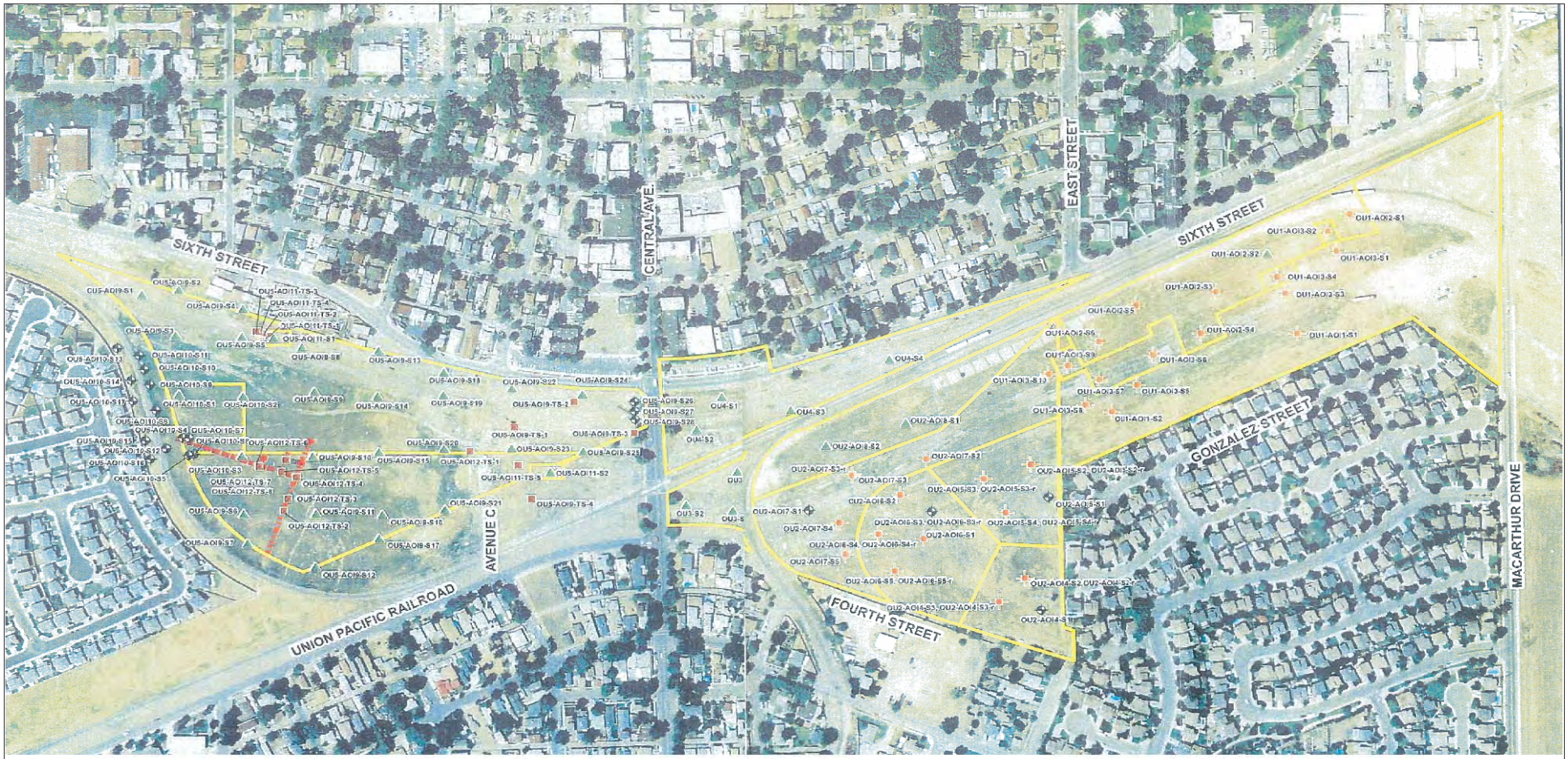
- conduct further remedial investigation,
- analyze the baseline risks to help determine the need for remedial action at the railyard,
- determine the levels of chemicals that can remain on site and still be adequately protective of human health, and
- gather data to evaluate feasible remedial alternatives.

Table 2 identifies the past investigations, including the 2006 Kennedy/Jenks study on behalf of Union Pacific, and reports the chemicals that warrant remediation based on state and federal thresholds. Figure 2 illustrates the sampling locations undertaken by Union Pacific as part of the Voluntary Clean-up. Based on these investigations, the site needs to be cleaned of elevated levels of lead and total petroleum hydrocarbons. Levels of arsenic are also elevated, but in most instances are consistent with background concentrations found in northern California soils.

EIP retained the services of Ninyo & Moore, Geotechnical and Environmental Sciences Consultants, to peer review the past investigations and to comment on the laboratory results. Ninyo & Moore examined three of the most recent and comprehensive summaries of site characterizations and remedial investigations (two by Geocon for the Tracy Multimodal Station and the 2006

Table 2
Bowtie Environmental Contamination Investigations and Results

Subarea	Past Investigations	Chemicals Exceeding Screening/Regulatory Levels
A	Environmental Site Assessment (Geomatrix), 2001 Site Characterizations (Geocon), 2004, 2005 Remedial Investigation Report (Kennedy Jenks), 2006	• Lead - exceeds residential but not industrial levels; elevated levels are found primarily in the northern portion • Arsenic - exceeds residential and industrial levels, but this finding is typical of background levels in northern California soils • Total Petroleum Hydrocarbons in soils and groundwater at the west end; lateral and vertical extent of groundwater impact undetermined
B	Level One Environmental Site Investigation (Engeo), 1991 Phase II Site Investigation (Industrial Compliance), 1992 Soil Sampling Workplan (Industrial Compliance), 1993 Workplan for Further Site Characterization (Industrial Compliance), 1993 Phase I Remedial Investigation (Kennedy Jenks), 2006	• Lead - exceeds residential and industrial levels along the northern border near Area I; previously remediated soils in southern portion are below residential thresholds • Arsenic - exceeds residential and industrial levels, but this finding is typical of background levels in northern California soils
C/D	Not investigated	Not investigated
E	See description for Area F	See description for Area F
F	Phase I Hazardous Materials Study (Espana), 1996 Preliminary Geotechnical Report (Espana), 1996 Limited Phase II Environmental Site Assessment (Kleinfelder), 1998 Phase I Environmental Site Assessment (Twining Laboratories), 2002 Phase II Environmental Site Assessment (Geocon), 2005.\ Phase I Remedial Investigation (Kennedy Jenks), 2006	• Lead - exceeds industrial PRG but not commercial/industrial CHHSL • Arsenic - exceeds residential and industrial levels, but this finding is typical of background levels in northern California soils • Total Petroleum Hydrocarbons, in soils primarily in the southern portion and in groundwater at the southwest corner; extent to the west is undetermined
G	See description for Area F	• Arsenic - exceeds residential and industrial levels, but this finding is typical of background levels in northern California soils • Total Petroleum Hydrocarbons throughout in soils and groundwater
H	See description for Area G	See description for Area G, although Area H appears to be outside the estimated extent of Total Petroleum Hydrocarbons in the soils
I	For the western half of I, see description for Area J; for the eastern half of I, see description for Area B.	• Lead - exceeds residential and industrial levels in eastern half along Area B; in western half, exceeds residential but not industrial levels • Arsenic - exceeds residential and industrial levels, but this finding is typical of background levels in northern California soils • Total Petroleum Hydrocarbons in the western half
J	Phase I Remedial Investigation (Kennedy Jenks), 2006	• Lead - exceeds residential but not industrial levels • Arsenic - exceeds residential and industrial levels, but this finding is typical of background levels in northern California soils • Total Petroleum Hydrocarbons in soils and groundwater • Metals - exceed residential but not industrial levels



Source: Kennedy/Jenks Consultants, April 2006.

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FIGURE **2**
Site Plan and Sampling Locations

Kennedy/Jenks Remedial Investigation for the former Tracy Railyard). Based on Ninyo & Moore's review, the previous investigations provide a solid database upon which to understand how the Bowtie's contamination could affect future redevelopment of the area. Background studies by Kennedy Jenks Consultants and Geocon provide sufficient data to make estimates of remediation costs for planning purposes. Finally, the Department of Toxic Substances Control issued a letter dated August 9, 2006 indicating that the agency concurred with the characterization of contamination in the soils.

Limitations of the Data. The above notwithstanding, there are three important caveats or qualifiers regarding the state of our knowledge about contamination in the Bowtie area.:

First, additional data are needed to understand the extent of contamination in the groundwater. The Geocon report for the multimodal station acknowledges that the San Joaquin County Environmental Health Department may require further assessment to determine the source of petroleum hydrocarbons. The installation of monitoring wells is expected to yield information on the lateral extent of impacts, which would then be used as a basis for determination of the need for remedial action. Similarly, the Kennedy/Jenks report concludes that further groundwater sampling is warranted to characterize the concentration of total petroleum hydrocarbons and to understand the western extent of groundwater impacts. The Department of Toxic Substances Control concurred with this conclusion and is anticipating further investigation of the groundwater at the west end of Area A, and in the southwest portions of Areas F and G. Given the likely sources of the groundwater contamination (contaminated soils and pipelines), the absence of this information should not significantly affect the future land uses (since redevelopment of the area would likely remove the sources of groundwater contamination).

Second, additional data would help refine the knowledge about areas that are contaminated and the amount of remediation required, though for the current exercise of master planning and formulation of a Specific Plan, the data are adequate. The amount of data collection and investigation is a function of the type of development projected for the site and how quickly development is expected to occur. As development plans for each subarea advance, further discussions with the regulatory agencies will determine what additional investigations might be warranted, if any, and allow refinements to the costs of clean up.

Third, Union Pacific is participating in a Voluntary Clean-Up program to better characterize the contamination (including information on the groundwater), undertake a health risk assessment, formulate a remediation work plan, and identify costs for clean up. EIP has been in regular communications with the Department of Toxic Substances Control since late summer 2006, to stay informed about Union Pacific's progress and to share that status with the City, but we have not been informed by the Department of Toxic Substances Control of the dates for Union Pacific's submittal,

in spite of information that suggests the remedial investigation and action plan should have been completed by now. As explained in our memorandum *Streamlining the Remediation Process* (September 28, 2006), it is important to keep the Department of Toxic Substances Control informed about the City's Specific Plan process and the desire to increase housing in the Bowtie area. With this understanding, the Department of Toxic Substances Control can work with Union Pacific to ensure that the clean-up levels they specify for the Bowtie area will be consistent with the proposal for residential uses there. At this point, we do not know if Union Pacific's study takes residential development into account, or if Union Pacific is only looking to clean the former railyard to commercial and industrial standards.

Future Land Uses in the Bowtie and Remediation Options

Parallel to the effort to characterize environmental contamination in the Bowtie area, FTB has investigated other conditions in the Downtown and Bowtie areas and identified a number of opportunities and strategies to enliven and revitalize Tracy's Downtown. These preliminary concepts have been reviewed with the public at community workshops and with the City Council at briefing sessions. A cornerstone of these concepts is the introduction of more housing to bring more people to the Downtown and to create momentum for the City's retail businesses and the multimodal transit station, which would be constructed in the Bowtie area.

Table 3 identifies the 10 areas that comprise the Bowtie area, the chemical compounds affecting the areas, the preliminary land use concepts for each area, and the need for remediation to permit the desired land use. Where remediation is necessary, the regulatory agencies must approve the clean-up method. Table 4 reviews the various remediation methods and highlights the differences among each. Based on this information, Table 5 identifies the likely remediation options for each area.

In general, it is expected that contamination in Areas A, B, and J can be remediated to allow residential uses by removing impacted soils and either placing them elsewhere in the Bowtie area (e.g., areas proposed for commercial/industrial uses) or hauling them off site for disposal. The multimodal transit station and parking areas proposed for Areas E, F, G, and H can be developed as a commercial/industrial site, with only limited removal of soils in hotspot locations. Again, the soils can be either placed elsewhere or hauled off site for disposal. Areas C, D, and I are the Congressional Land Grant areas and will be used for transportation-related uses, pedestrian/bicycle paths, and basketball courts. For hazardous clean-up purposes, they are regarded as proposed commercial uses.

On-site Reuse of Soils. Impacted soils from Areas A, B, and J would need to be treated to stabilize the lead, and since soils from Areas A and J would likely have elevated levels of Total Petroleum Hydrocarbons, the soils there would also need treatment, either by stockpiling and introducing nutrients to accelerate the natural degradation process or by excavating and hauling. The soluble lead concentrations in the soil will determine whether they can be treated on site or need to be removed

Table 3
Bowtie Areas Requiring Remedial Action

Subarea	Chemicals Exceeding Screening/Regulatory Levels	Preliminary Land Use Proposals	Will Remediation be Expected to Accommodate Proposed Land Use?
A	• Lead - exceeds residential but not industrial levels; elevated levels are found primarily in the northern portion • Arsenic - exceeds residential and industrial levels, but this finding is typical of background levels in northern California soils • Total Petroleum Hydrocarbons in soils and groundwater at the west end; lateral and vertical extent of groundwater impact undetermined	Primarily residential	Yes, to address lead, arsenic, and Total Petroleum Hydrocarbons in the soil; further characterization of groundwater contamination with monitoring
B	• Lead - exceeds residential and industrial levels along the northern border near Area I; previously remediated soils in southern portion are below residential thresholds • Arsenic - exceeds residential and industrial levels, but this finding is typical of background levels in northern California soils	Primarily residential	Yes, to address lead and arsenic in the soil
C/D	Not investigated	Transportation-related uses, pedestrian/bike path, basketball courts	Yes, but likely limited to hotspots where public could be exposed to soils
E	See description for Area F	Multimodal transit station	Yes, but likely limited to hotspots; further characterization of groundwater contamination with ongoing monitoring
F	• Lead - exceeds industrial PRG but not commercial/industrial CHHSL • Arsenic - exceeds residential and industrial levels, but this finding is typical of background levels in northern California soils • Total Petroleum Hydrocarbons, in soils primarily in the southern portion and in groundwater at the southwest corner; extent to the west is undetermined	Multimodal transit station	Yes, but likely limited to hotspots; further characterization of groundwater contamination with ongoing monitoring
G	• Arsenic - exceeds residential and industrial levels, but this finding is typical of background levels in northern California soils • Total Petroleum Hydrocarbons throughout in soils and groundwater	Multimodal transit station parking	Yes, but likely limited to hotspots; further characterization of groundwater contamination with ongoing monitoring
H	See description for Area G, although Area H appears to be outside the estimated extent of Total Petroleum Hydrocarbons in the soils	Multimodal transit station parking	Yes, but likely limited to hotspots; further characterization of groundwater contamination with ongoing monitoring
I	• Lead - exceeds residential and industrial levels in eastern half along Area B; in western half, exceeds residential but not industrial levels • Arsenic - exceeds residential and industrial levels, but this finding is typical of background levels in northern California soils • Total Petroleum Hydrocarbons in the western half	Transportation-related uses, pedestrian/bike path, basketball courts	Yes, to address lead, arsenic, and Total Petroleum Hydrocarbons in the soil; further characterization of groundwater contamination with monitoring
J	• Lead - exceeds residential but not industrial levels • Arsenic - exceeds residential and industrial levels, but this finding is typical of background levels in northern California soils • Total Petroleum Hydrocarbons in soils and groundwater • Metals - exceed residential but not industrial levels	Primarily residential	Yes, to address lead, arsenic, and Total Petroleum Hydrocarbons, and metals in the soil; further characterization of groundwater contamination with monitoring

Table 4
Summary of Pros and Cons of Remedial Alternatives

Alternative	Pros	Cons
Soils		
No action	• No cost • Easy implementation	• Regulatory closure unlikely, restricting use of the site • Human health risks not mitigated • Likely continued effect on groundwater
Reuse Impacted Soil On Site	• Cost effective and convenient • Also if lead were encapsulated and soil were stabilized, lower environmental risk and reduced effects on groundwater • Limited transportation costs, since impacted soils would be moved among subareas • Allows quicker development on targeted sites/subareas	• Excavation would be needed on "receiver sites" to accommodate acceptance of impacted soils, resulting in transportation costs and hauling effects • Receiver sites would need to be capped and groundwater would need to be monitored • Cap on receiver sites could be expensive and need to be monitored • Increases contamination level of receiver sites, which may be acceptable depending on the proposed land use for those sites/subareas
Excavate and Haul Off Site	• Highest level of site clean-up • Greatest reduction of environmental risk • Greatest reduction of effects on groundwater • Can be implemented relatively quickly	• Higher costs associated with excavation, hauling, and disposal • Even higher costs for disposal if soils are classified as hazardous • Greater volume of contaminated soils increases short-term exposure for site workers
Bioventing/Biodegradation	• Reduced initial clean-up costs, typically involving the addition of oxygen to the subsurface to allow natural biodegradation • No short-term transportation costs or hauling effects	• Effective only for soils impacted with Total Petroleum Hydrocarbons • Long time may be needed to achieve desired clean-up levels, although this can be overcome with enhanced and more costly bioremediation techniques • Weekly maintenance • If soils have high metal concentrations or high soil moisture, bioventing has limited effectiveness
Groundwater		
Monitored natural attenuation	• Easily implemented • Effective provided that natural degradation processes are present	• Effective only if natural degradation process are present • Effective only if groundwater contamination is limited in extent • Requires ongoing monitoring and reporting
Biodegradation by air sparging or injection of oxygen-producing compounds	• Relatively easy to implement • Most effective if contamination is not too deep and extent is known	• May take time to achieve desired clean-up levels • Requires ongoing monitoring and reporting
Biodegradation by chemical oxidation	• Relatively easy to implement • Since oxidizing compound is injected into contamination zone, effective for larger contaminated plumes	• May take time to achieve desired clean-up levels • Requires ongoing monitoring and reporting
Pump and treat	• Effective at controlling migration of contamination • Most effective at reducing the mass of a contaminant in groundwater	• Most costly and typically requires the longest time

Table 5
Remedial Alternatives by Bowtie Subareas

Subarea	Preliminary Land Use Proposals	Will Remediation be Expected to Accommodate Proposed Land Use?	Primary Remedial Options
A	Primarily residential	Yes, to address lead, arsenic, and Total Petroleum Hydrocarbons in the soil; further characterization of groundwater contamination with monitoring	• Onsite reuse and bioventing: excavate and place on proposed commercial/industrial areas (C, D, E, F, G, H, I) • Excavate and dispose off site
B	Primarily residential	Yes, to address lead and arsenic in the soil	• Onsite reuse: excavate and place on proposed commercial/industrial areas (C, D, E, F, G, H, I) • Excavate and dispose off site
C/D	Transportation-related uses, pedestrian/bike path, basketball courts	Yes, but likely limited to hotspots	• Onsite reuse and bioventing: accept impacted soils and cap
E	Multimodal transit station	Yes, but likely limited to hotspots; further characterization of groundwater contamination with ongoing monitoring	• Onsite reuse and bioventing: accept impacted soils and cap • Excavate and dispose off site
F	Multimodal transit station	Yes, but likely limited to hotspots; further characterization of groundwater contamination with ongoing monitoring	• Onsite reuse and bioventing: accept impacted soils and cap • Excavate and dispose off site
G	Multimodal transit station parking	Yes, but likely limited to hotspots; further characterization of groundwater contamination with ongoing monitoring	• Onsite reuse and bioventing: accept impacted soils and cap • Excavate and dispose off site
H	Multimodal transit station parking	Yes, but likely limited to hotspots; further characterization of groundwater contamination with ongoing monitoring	• Onsite reuse: accept impacted soils and cap • Excavate and dispose off site
I	Transportation-related uses, pedestrian/bike path, basketball courts	Yes, to address lead, arsenic, and Total Petroleum Hydrocarbons in the soil; further characterization of groundwater contamination with monitoring	• Onsite reuse and bioventing: accept impacted soils and cap • Excavate and dispose off site
J	Primarily residential	Yes, to address lead, arsenic, and Total Petroleum Hydrocarbons, and metals in the soil; further characterization of groundwater contamination with monitoring	• Onsite reuse and bioventing: excavate and place on proposed commercial/industrial areas (C, D, E, F, G, H, I) • Excavate and dispose off site

and hauled off site. All areas that are intended to be used as "receiver sites" for the lead (i.e., the sites proposed for commercial/industrial uses) would need to be capped to prevent public exposure to the soils. Depending on the proposed land use, the capping could be accomplished using asphalt or concrete, both of which create an impervious layer but concrete is roughly twice as expensive as asphalt. Under this option, the regulatory agencies would require ongoing monitoring.

Excavate and Dispose Off Site. This option provides for the most effective reduction in the mass of contamination on site and is most protective of the public health and safety and the underlying groundwater. The biggest variable associated with this option concerns the classification of the excavated soils as clean, contaminated but non-hazardous, or hazardous. Soils classified as hazardous must be disposed in permitted landfills. In terms of cost, non-hazardous soil hauling is estimated at $80/ton; whereas, hazardous soil hauling is approximately $140/ton.

Groundwater Monitoring and Treatment. At this stage, groundwater characterization is not complete. In particular, the lateral and vertical extent of the groundwater contamination has not been determined. Geocon was asked by the City to conduct and prepare an Additional Site Investigation Report, specifically for the purpose of better defining the contamination around the multimodal transit station. Their recommendation for the site is "monitored natural attenuation," which involves monitoring the naturally occurring degradation process in the groundwater and submitting the results to the regulatory agencies on a quarterly basis. Other, more aggressive techniques may be required by the regulatory agencies for remediation at the western end of Area A and along the northern portions of Area B. Cost estimates for this treatment are identified in Geocon's Additional Site Investigation Report. The monitored natural attenuation approach would range typically from $20,000 to $30,000 per year. If a more aggressive effort involving introduction of oxygen-producing compounds or another oxidizing compound were applied, costs could range from $100,000 to $300,000, depending on the number of wells and length of time required to achieve the remedial goal. These costs would only address the cleanup of groundwater around the multimodal transit station and parking in Areas F and G. Given the range of options and the need to still characterize the groundwater contamination, groundwater remediation costs are still undetermined.

Union Pacific Voluntary Clean-up. Based on recent conversations with the Department of Toxic Substances Control, Union Pacific is conducting further remedial investigations and feasibility studies to identify clean-up levels, human health risks, and remediation options. Assuming that Union Pacific would remediate conditions for commercial/industrial uses in advance of selling or as part of a sales agreement, the City and land developers would have land that could be developed for commercial/industrial uses, such as the multimodal transit station or parking areas. There would be an incremental cost associated with further remedial actions to allow the land (i.e., Areas A, B, and J) to be suitable for housing.

Summary. Table 6 presents each of the remediation options by area and provides order-of-magnitude cost estimates for the various options. The costs assume that the lead and Total Petroleum Hydrocarbon impacted soils are considered to be non-hazardous, which allows them to be disposed of in any number of nearby landfills. Notably, reusing soils on site is demonstrably more expensive than excavating and disposing off site. Under the on-site reuse option, the savings in transportation costs are offset by the costs of capping the "receiver sites" (i.e., Areas C – I).

In summary, assuming that Union Pacific cleans the Bowtie area to commercial/industrial standards by excavating and disposing impacted soils off site and that the removed soils are not classified as hazardous, then there will still be incremental costs needed to provide the additional remediation needed for residential uses on Areas A, B, and J. Under the less expensive scheme of excavating and hauling, additional clean-up costs to remediate soils in the targeted areas for residential uses are in the neighborhood of $4.1 million. If all of the soils to be excavated are considered hazardous, then the costs to remediate soils in the targeted residential areas would be $8.6 million. To this amount would be the added cost of monitoring and possibly treating the groundwater. The costs of $8.6 million would be a worst-case scenario, and there are various methods of reducing the contamination levels of the soils so that they could be disposed of in a landfill that accepts non-hazardous wastes.

We are available to discuss the contents of this summary further and look forward to the next steps in the planning process.

Cordially,

Rod Jeung, AICP
Sr. Program Manager

Table 6
Bowtie Remediation Costs by Area/Remediation Option

Area A					
Option 1: onsite reuse, place impacted soils on Areas C-I and cap; separate TPH soils and allow to biodegrade naturally before reusing on Areas C-I and capping	**Remedial Actions**	**Amount**	**Unit Cost**	**Cost**	
	1) Remediate/Stabilize Lead	8,000 cy	$15-$21/cy	$120,000	$168,000
	2) Move Impacted Soils	8,000 cy	$3/cy	$24,000	
	3) Cap	888,624sf	$4-$8/sf	$3,554,496	$7,108,992
Option 2: excavate and haul off site	1) Excavate/Dispose	13,360 tons	$80/ton	$1,068,800	
Area B					
Option 1: onsite reuse, place impacted soils on Areas C-I and cap Area B has no TPH soils	**Remedial Actions**	**Amount**	**Unit Cost**	**Cost**	
	1) Remediate Lead	2,500 cy	$15-$21/cy	$37,500	$52,500
	2) Move Impacted Soils	2,500 cy	$3/cy	$7,500	
	3) Cap	888,624sf	$4-$8/sf	already covered in Area A costs	
Option 2: excavate and haul off site	1) Excavate/Dispose	4,175 tons	$80/ton	$334,000	
Areas C/D/I					
Option 1: onsite reuse, accept impacted soils from elsewhere, cap Areas C/D/I; assume TPH soils are already remediated through bioventing	**Remedial Actions**				
	Soil moving, capping, and bioventing already included in Option 1 for Areas A, B, and J				
Areas E/F/G/H					
Option 1: onsite reuse, accept impacted soils from elsewhere, cap Areas E-H; assume TPH soils are already remediated through bioventing	**Remedial Actions**				
	Soil moving, capping, and bioventing already included in Option 1 for Areas A, B, and J				
Option 2: excavate and haul off site	1) Excavate/dispose	3,340 tons	$80/ton	$267,200	
Area J					
Option 1: onsite reuse, place impacted soils on Areas C-I, cap; in situ bioventing TPH soils	**Remedial Actions**	**Amount**	**Unit Cost**	**Cost**	
	1) Remediate Lead	20,958 cy	$15-$21/cy	$314,370	$440,118
	2) Move Impacted Soils	20,958 cy	$3/cy	$62,874	
	3) Cap	888,624sf	$4-$8/sf	already covered in Area A costs	
	4) Biovent TPH Soils	19,000 tons	$168/ton	$3,192,000	
Option 2: excavate and haul off site	1) Excavate/dispose lead	35,000 tons	$80/ton	$2,800,000	
	2) Excavate/dispose TPH soils	19,000 tons	$80/ton	$1,520,000	
Option 1 total				*$7,312,740*	*$11,048,484*
Option 2 total				*$5,990,000*	
LESS Voluntary Clean-up to Commercial/Industrial Standards (assumes excavation and off-disposal of impacted soils to achieve commercial/industrial remediation goals)				**$1,910,880**	**$3,336,480**
Option 1 recognizing possible clean up by Union Pacific				**$5,401,860**	**$7,712,004**
Option 2 recognizing possible clean up by Union Pacific				**$4,079,120**	