# Attachment 1

## Summary of Baylands Hazrdous Materials – Landfill Studies

Over the years, a number of site and waste charcterization and other studies have been conducted to support eventual preparation of remedial action plans and plans and Title 27 landfill closure plans. The information provided in thee reports for the landfill, OU-1 and OU-2 were obtained from the subsurface soil and groundwater investigations and ongoing monitoring. These investigations and studies, which are also described in the Draft EIR, are summarized below.

- **Preliminary Geotechnical Investigation – 1977**. John V. Lowney & Associates completed a preliminary geotechnical investigation for the landfill to assess geotechnical issues associated with development for commercial and industrial use. The report concluded that development of the landfill site for these uses was feasible. The primary concerns identified in the report for construction were the control of methane gas, which had been previously measured at explosive levels within the landfill and the potential for differential settlement.
- **Environmental Assessment of Fill – 1982**. In 1982, Harding Lawson Associates conducted an environmental assessment of the former railyard, which consisted of drilling and collecting soil samples from 25 shallow boreholes and installing monitoring wells in 24 of the boreholes to assess the presence of contaminants. Groundwater samples were collected from these wells and one deep production well. Ten soil samples, 24 groundwater samples, and one oil sample from the vicinity of the oil tank were collected and submitted for chemical analysis. Groundwater was analyzed for heavy metals, VOCs, SVOCs, pH and TOCs.
- **Soil and Groundwater Investigation – 1985**. In 1984, Ecology and Environment, Inc. conducted a two-phase environmental investigation at the former railyard. The first phase of the investigation included measuring water levels in 24 wells and collecting groundwater samples from 18 wells. The second phase, undertaken in 1985, included drilling and collecting soil samples from 41 soil borings, and installing and collecting soil and groundwater samples from 14 new shallow groundwater basin wells and 13 new deep groundwater basin wells. A total of 136 soil samples and 46 groundwater samples were collected and analyzed. Groundwater levels were measured and the flow direction evaluated. Groundwater samples were analyzed for VOCs and metals. Arsenic and other metals were detected in groundwater, inlcuding, copper, chromium, and zinc.
- **Remedial Action Alternative Feasibility Study – 1986**. In 1985 and 1986, the Mark Group performed a Remedial Action Alternative Feasibility Study for the former railyard, which included drilling and collecting soil samples from 21 soil borings, 9 shallow groundwater basin wells, and five deep groundwater basin wells. A total of 69 soil samples were collected from soil borings and well borings, and 41 groundwater samples were collected and analyzed. The Mark Group also measured water levels in the wells, performed some small-scale aquifer tests to estimate hydraulic conductivities and aquifer interconnections, and made limited measurements of tidal fluxes. Groundwater samples were analyzed for metals and VOCs. Arsenic, barium, chromium, methylene chloride, TCE, and xylenes were detected in groundwater samples. The Mark Group also sampled existing wells for VOCs and metals, and detected TCE as high as 1,000,000 µg/L in a well near the Schlage Lock site.
- **Detection Monitoring Program Investigation – 1987**. The first comprehensive soil, groundwater, and surface-water quality evaluation at the former landfill was performed by SPTC in 1987. Twenty-

eight (28) samples[1] of materials underlying the refuse fill area and the railyard (just upgradient of the landfill) were collected and analyzed for VOCs, SVOCs, phenols and 14 priority pollutant metals (PPMS)[2]. The report stated that "... it appears that disposal operations have impacted soil chemical quality below the landfill area." However, "With the exception of three semi-volatile organic compounds: phenanthrene, pyrene, and chrysene, the levels of chemical constituents detected were found at low levels which should not be of environmental concern. These compounds were detected only at shallow depths in the Bay mud and are generally considered to have low mobility."

Additionally, 15 groundwater samples were collected from shallow groundwater zone and deep groundwater zone monitoring wells and analyzed for VOCs, SVOCs, phenols, oil and grease, 13 PPMs, nitrate, Total Kjeldahl Nitrogen, general mineral and physical parameters[3], oxidation and reduction potential, and total and fecal coliforms. A variety of VOCs and SVOCs were detected at low levels. In general, a greater number of constituents were detected in the last areas to be filled than in earlier fill areas.

- **Groundwater Monitoring Program –1989**. In 1989, S.S. Papadopoulos & Associates Inc. developed and implemented a semiannual groundwater monitoring program for the former railyard. Papadopoulos sampled groundwater and measured water levels in the 40 wells at the site and collected and analyzed two samples of water from the onsite ditch. The groundwater samples were analyzed for VOCs, BTEX, and metals. Metals detected included arsenic, barium, chromium, copper, lead and zinc.

- **Groundwater Monitoring – 1989**. HCI conducted groundwater sampling at the former railyard. Water levels were measured and samples collected from 31 wells. HCI also removed 11,500 gallons of oil-contaminated water and sediments from the on-site drainage ditch for off-site treatment and recycling.

- **Remedial Investigation Data Study – 1989**. HCI completed a Remedial Investigation Data Study report for the former railyard to review and interpret data generated in the previous investigations, and to identify data gaps and additional work needed to allow better definitions of the nature and extent of contamination and potential risks, and to design effective remedial actions. To meet these objectives, HCI developed a Supplemental Remedial Investigation Work Plan concluding that:
  - Low to moderate concentrations of metals were found in soils at many locations.
  - Oil and/or fuel type organic materials were observed in soils underlying the turntable and former oil tank location by all previous investigators.
  - The presence of VOCs in soils appeared to be limited to low levels of chlorinated hydrocarbons in the northwest corner of the site, where they are closely related to the extent of VOC's in groundwater.

- **Phase 1 Geotechnical Investigation – 1990**. Kleinfelder conducted a geotechnical investigation to evaluate foundation requirements for future development of the landfill area. They also conducted an evaluation of the extent of refuse at the site and installed soil gas and gas pressure probes to provide additional information for design of a landfill gas extraction system.

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1 Including 27 samples of Young Bay Mud and one sample of silty sand underlying the Young Bay Mud.

2 PPMs included antimony, arsenic, beryllium, cadmium, chromium, copper, iron (soil samples only), lead, mercury, nickel, selenium, silver, thallium and zinc.

3 General mineral and physical parameters included color, odor, turbidity, bicarbonate/carbonate and hydroxide alkalinity, calcium, chloride, foaming agents (MBAS), iron, magnesium, manganese, pH, potassium, sodium, sulfate, specific/electrical conductance, total dissolved solids (TDS), total hardness and fluoride.

- **Air Quality Solid Waste Assessment – 1990**. The Air Quality Solid Waste Assessment Test field program at the former landfill consisted of landfill gas sampling, ambient air sampling, gas migration testing, and instantaneous surface monitoring performed in October-November 1989 and in May 1990. Gas stream characterization revealed the presence of methane gas in all samples. Additionally, benzene was detected in two samples. Instantaneous surface monitoring was conducted in October-November of 1989, and detected methane. Supplemental testing conducted in May 1990 confirmed the existence of these interior gas "seep" areas. Ambient air sampling indicated that air contaminants were not emitted from the landfill into the ambient atmosphere at levels that would likely pose a potential threat to public health or safety or a threat to the environment. Gas migration testing was performed at eight perimeter probe locations.
- **Supplemental Remedial Investigation – 1990**. L-F implemented the Work Plan for the former railyard prepared by HCI in 1989. The field work and laboratory analyses included a soil gas/ groundwater survey, soil characterization from shallow trenches and deeper borings, surface soil sampling, air sampling, piezometer and monitoring well installation, groundwater and surface-water sampling, hydraulic testing and tidal fluctuation monitoring. The majority of work was performed in the OU-2 area. Forty shallow borings were drilled to collect samples and make visual observations to identify the lateral and vertical extent of chemical-affected soils. The results were used to refine the locations for eight new wells and 10 piezometers. Additionally, eight groundwater monitoring wells were installed in the deep groundwater basin to better characterize quality and flow of the deeper water bearing unit. Three general areas of concern at the site were identified:
    - North Area – High concentrations of chlorinated VOCs were detected, along with a localized area of oil in the extreme northwest corner of the site.
    - Turntable and Oil Tank Areas – Petroleum hydrocarbons, primarily heavy, viscous Bunker C oil, were observed throughout this area and off-site to Industrial Way. Other lighter fraction oils were also identified in the Turntable Area.
    - South Disposal Area – Metals were detected in soils at concentrations above regulatory standards. The principal metals of concern included arsenic, copper, mercury and lead, although other metals have also been detected.
- **Water Quality Solid Waste Assessment – 1992**. Kleinfelder conducted a Water Quality Solid Waste Assessment Test (SWAT) investigation to evaluate whether the landfill had an adverse effect on water quality. The report concluded that organic compounds had been detected and had impacted the shallow water bearing groundwater zone above the Young Bay Mud. The report also concluded that the Young Bay Mud was an effective barrier and coupled with the observed upward vertical groundwater gradient, should prevent the downward migration of contaminants. The report also concluded that the refuse layer of the landfill did not appear to be tidally influenced and that contamination at the site would not be classified as a hazardous waste under California regulations. The report also stated that groundwater (within and immediately adjacent to the landfill) and surface water (crossing and adjacent to the landfill) contained naturally occurring minerals (e.g., chloride, TDS, iron and manganese) at concentrations in excess of non-health related drinking water standards (secondary maximum contaminant levels). As such, these waters would not be considered a potential drinking water source as defined by the State Water Resources Control Board.
- **Interim Remedial Investigation – 1995**. This investigation included historical research and assessment of the Baylands and the Schlage property, along with historical research and assessment of the Bodinson, Norton Trust, and SPTC properties as well as an assessment of the Schlage and the Baylands sites. Results confirmed the presence of CVOCs, total petroleum hydrocarbons, and metals in groundwater and soil.

- **Field Investigation, Project Site and Schlage Site – 1998**. This investigation provided additional characterization of VOC distribution in groundwater near the boundary between the Baylands and the Schlage property. The investigation included groundwater sampling at various depths, soil sampling, and a passive soil gas survey.
- **Landfill Footprint Delineation – 2000**. Geosyntec performed two investigations to identify property owners and to delineate the footprint of the former landfill. Additionally, Subsurface Consultants, Inc. completed a technical review of geologic information to delineate the northern extent of the landfill.
- **Landfill Cover Thickness Investigation – 2001**. An existing soil cover thickness investigation performed in August 2000 consisted of drilling 40 borings to the top of waste within the landfill. Locations of these borings supplemented borings drilled in March 2000 as part of the waste extent delineation program. Based on the results of the 2000 investigations, a contour map of the soil cover thickness was prepared. According to the map, the thickness of the cover material generally ranged from 1 to 37 feet. The report noted, however, that because of ongoing soils recycling operations on the landfill and on-going settlement of refuse and underlying Bay Mud, development of contour maps for the top of refuse and top of Bay Mud that identify both pre-2000 elevations and 2000 data was not possible.
- **Interior Drainage Channel Investigation – 2002**. This investigation evaluated the depth to landfill waste beneath the interior drainage channel for use in planning and channel liner system design. According to the report, waste is generally present under the channel throughout the landfill at depths of 3 to 6 feet below the existing channel surface.
- **Proposed Final Closure and Post-closure Maintenance Plan – 2002**. Proposed final closure and post-closure maintenance plans for the former landfill were prepared to address requirements of Sections 20950-21200 of Title 27. The plans proposed to install a final cover system over the entire former landfill consisting of the following layers (from bottom to top):
  - a minimum 2-ft thick soil foundation layer (in-place soil);
  - a low-hydraulic conductivity layer (flexible membrane liner (FML) or a minimum 1-ft thick compacted clay liner (CeL), with a maximum hydraulic conductivity of 1 x 10-6 cm/s); and
  - an erosion-resistant layer "of sufficient thickness to allow for the installation of utilities at the proper depths without harming the low-hydraulic conductivity layer."

  The former landfill's final closure and post-closure maintenance plans were conditionally approved by the Regional Water Quality Control Board. Additionally, the Local Enforcement Agency, San Mateo County Environmental Health Division, reviewed the final closure and post-closure maintenance plans, and provided their preliminary comments.
- **Remedial Investigation Report Joint Groundwater Operable Unit – 2002**. This investigation evaluated the nature and extent of groundwater contamination beneath both the former Schlage Lock and the Brisbane portion of OU-1. The investigation (1) evaluated the hydrogeology and geology of the site as it relates to groundwater and contamination migration; (2) compiled available groundwater chemical data into a single document along with a representative summary of hydrogeological data and information; (3) characterized the nature and extent of contamination in area groundwater; (4) evaluated transport routes of the chemical substances present in groundwater at the site; and (5) developed data necessary for the preparation of a Risk Assessment and subsequent Remedial Action Plan for the groundwater at the site. The chemicals of concern were identified as CVOCs. The report also presented an outline of the objectives of the groundwater remedy (i.e., pump and treat) that was operating at the time.
- **Soil Conditions Summary – 2005**. Burns & McDonnell summarized existing OU-1 soil analytical data. It was reported that the highest concentrations of VOCs (PCE and TCE) were detected

topographically down slope of the Schlage buildings and parking lot immediately adjacent to the Schlage property line. TCE, PCE, TPH were detected. Confirmatory samples taken from the walls of the sludge pit excavation did not show a detection of TPH above the method detection limit. Metals were detected in shallow soils in all 51 locations sampled. Arsenic, chromium and lead were detected, in some cases exceeding screening criteria.

- **Soil and Groundwater Sampling – 2005/2006**. Fifty-eight (58) borings were taken within OU-1 during collection of soil and groundwater samples between December 2005 and September 2006. Soil samples were analyzed for metals and VOCs, while groundwater samples were analyzed for VOCs. Soil impacts due to arsenic, lead, cadmium, mercury and chromium were further delineated.
- **Landfill Gas Surface Emission Evaluation – 2006**. Geosyntec performed an evaluation of landfill gas surface emissions at the former landfill in June 2006. The work followed the requirements of federal (Subpart WWW[4]) and state (Rule 34 of Regulation 8 by the BAAQMD) regulations for surface emissions. The landfill gas surface emission survey indicated no detection of landfill gas along the perimeter or within the landfill.
- **Soil Sampling Summary Report – 2006**. Soil and shallow groundwater sampling was performed at the San Francisco and Brisbane portions of OU-1 in December 2005 and January 2006 to supplement existing data from previous subsurface investigations, reduce the spacing between soil and groundwater sampling locations, and to further characterize the soil and groundwater. Soil samples from 25 borings were analyzed for metals (arsenic, barium, cadmium, chromium, lead, mercury, selenium and silver) and from 20 borings for VOCs. Groundwater samples obtained from 6 borings were analyzed for VOCs. The analytical results of 48 soil samples indicated the presence of metals, at concentrations exceeding screening levels or background level across the site. VOC detections in soil samples were limited to a small area east and south of the Schlage Lock property line.
- **OU-1 Additional Investigation – 2006**. An additional soil and groundwater investigation was performed in the San Francisco and Brisbane portions if OU-1 to further assess the quality of soil and groundwater. Thirty-three borings were drilled to approximately 12-15 feet below the ground surface and soil and groundwater samples were obtained. Selected soil samples were analyzed for metals (arsenic, barium, cadmium, chromium, copper, lead, mercury, selenium and silver) and CVOCs, while groundwater samples were analyzed for CVOCs only. The laboratory results of 19 soil samples indicated that concentrations of a number of metals exceeded their respective background concentrations, including arsenic, chromium, lead, and mercury. Eight out of 33 soil samples analyzed for VOCs indicated the presence of TCE, PCE and toluene. Groundwater samples collected from the 33 borings indicated the presence of nine VOCs.
- **Preliminary Geotechnical Investigation and Recommendations Report – 2008**. Geosyntec developed preliminary geotechnical conclusions and recommendations for future development of the former landfill based on the field investigations, laboratory testing and evaluations of available subsurface data. Findings and recommendations included:
    - The subsurface stratigraphy from the ground surface down consists of 10 to 40 ft of non-engineered fill over approximately 20 to 35 ft of waste underlain by soft to stiff Young Bay Mud and Old Bay Mud, which consist of clays and silts with sand layers.
    - The water levels are between elevations +5 ft and + 10 ft mean sea level (msl).
    - In general, bedrock is within the elevations shown on the 1969 California Division of Mines and Geology regional map or closer to the surface with localized variations.
    - A relatively thick sand layer was encountered in the northern portion of the site.

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4 Section 60.755(c) and/or (d) (Subpart WWW) of Title 60 of the Code of Federal Regulations (CFR).

- Settlement of the waste fill, the Young Bay Mud and a portion of the Old Bay Mud are expected. Differential settlements will affect structures and will induce downdrag loads in deep foundations. Placing fill over non-engineered fill and refuse will cause uneven settlement. Design and construction of structures and placement of fills over refuse should, therefore, consider the impacts of short- and long-term settlement.
- Engineered fill materials are to be non-expansive, free of organics and debris, and compacted at 90 percent relative compaction, unless modified by the final design. Structural fill and retaining wall fill need to be compacted at 95 percent relative compaction. The top 5 feet of fill should be compacted to 95 percent relative compaction and within 3 percent of the optimum moisture content.
- Shallow Foundations (i.e., slab-on-grade and shallow footings) may be an option if buildings are monitored for differential settlement and the foundations are repaired (e.g., slab jacking, grouting, etc.). Settlement may cause grade reversal and therefore affect the long-term performance of undergound utilities. Flexible joints will be necessary.
- Deep Foundation. For structures that cannot tolerate differential settlement, deep foundations are recommended. Piles must be designed in accordance with applicable local/state ordinances and requirements. Compatibility of pile materials must be evaluated with leachate and sea water.

- **Leachate Management Plans - 2002-2008**. As required by Regional Water Quality Control Board (RWQCB) Waste Discharge Requirements, the landowner submitted a Leachate Management Plan for the landfill in 2002. The Leachate Management Plan considered two methods of leachate collection and extraction: (1) a french drain along the landfill perimeter and/or slurry wall; and (2) a series of leachate extraction wells strategically located for suitable operation. In 2006, in response to a request by the RWQCB, UPC submitted a revised Leachate Management Plan that proposed a seep mitigation program designed to improve water quality parameters for Brisbane Lagoon seeps and overall lagoon water beyond those required by the RWQCB to protect ecological receptors. The RWQCB approved the revised Leachate Management Plan in 2007. The revised plan provides interim management of landfill leachate under current (i.e., pre-development) site use. In 2008, a Draft Leachate Management Plan was prepared to establish a long-term approach for managing leachate and to provide a basis for planning of future landfill development. The 2008 Draft Leachate Management Plan was intended to remain in "draft" status until completion and certification of an EIR for Baylands development so that applicable mitigation measures can be incorporated into the plan.
- **Sampling and Analysis for Lead and Arsenic in Soil – 2009**. Mactec further characterized the extent of arsenic and lead-impacted soil in the San Francisco portion of OU-1 to fill a data gap identified in the 2009 Feasibility Study / Remedial Action Plan. In addition, a limited number of soil samples were analyzed for PCBs and pesticides. Based on analysis of samples from 46 soil borings, the extent of soil above risk-based cleanup levels for arsenic and lead was identified. Arsenic was found to be more widespread than lead, but limited to near-surface soils and considered to be the result of spraying of lead arsenate herbicides. PCBs or pesticides were either not detected or detected below screening values in the soil samples.
- **Landfill Groundwater, Surface-Water and Leachate Monitoring – 2002-Present**. Semiannual groundwater, surface-water, and leachate monitoring has been performed at the former landfill pursuant to RWQCB Waste Discharge Requirements since 2002. The monitoring results confirm that the shallow groundwater zone at the landfill has been impacted by the waste. However, the Young Bay Mud that separates the shallow and deep groundwater zones, along with the upward hydraulic gradient, prevents contamination of the deep groundwater zones. Results of the surface-water monitoring in the Brisbane Lagoon and internal drainage channel indicated low concentrations of the target chemicals. Additionally, Screening-Level Ecological Risk Assessments performed for seeps

discharging to the Brisbane Lagoon and internal drainage indicate that they do not pose a significant threat to the environment.

- **Groundwater Monitoring – Ongoing**. Groundwater monitoring has been carried out at the San Francisco and Brisbane portions of OU-1 since 1995, in accordance with the Operation and Maintenance agreement between DTSC and the landowner. Groundwater samples from all wells have been analyzed for CVOCs. Also, groundwater from designated wells has been analyzed for TPH, total chromium, hexavalent chromium, benzene/toluene/ethylbenzene/ xylenes, and MTBE. Since the third quarter of 2008, Mactec has conducted quarterly groundwater monitoring events for the San Francisco portion of OU-1.

- **Settlement Evaluation Program – 2008-Present**. A settlement monitoring program was implemented at the former landfill to evaluate short- and long-term settlement, and to calibrate the settlement model developed for the landfill. The model considers primary and secondary settlements of the cover soil, waste, Young Bay Mud and Old Bay Mud. The program includes quarterly and semiannual monitoring of four deep settlement monitoring systems (i.e., two Sondexes at two landfill locations) and 30 shallow settlement monuments.

- **Characterization Study, Brisbane Landfill – 2008**. An independent review of publicly available site assessment reports, as well as groundwater and landfill gas monitoring data was conducted by Golder Associates and presented to the Brisbane Baylands Community Advosory Group (BBCAG). The review notes that the landfill had received industrial and shipyard wastes, and that although these wastes were not specifically characterized, it would not be unreasonable that they may have included hazardous waste. There is, however, no specific evidence to support such an assumption. The report also noted that it is generally accepted that the landfill would have received household hazardous wastes. The report stated that monitoring, analysis and testing performed to date indicated that the hazardous waste constituents in the groundwater, leachate and leachate seeps are consistent with other landfills in the Bay Area. Golder's overall conclusion was that, based on the publicly available reports, there is no specific evidence that hazardous waste was disposed in the landfill.

- **Risk-Based Cleanup Levels – 2009**. Mactec calculated risk-based clean-up levels for constituents of concern in soil within the Brisbane and San Francisco portions of OU-1, including PAHs, arsenic, cadmium, lead and mercury. The maximum concentrations for the constituents of concern in soil were compared by MACTEC to regulatory screening levels, which included the California Environmental Protection Agency Human Health Screening Levels. Although the maximum concentration of chromium in the Brisbane portion of OU-1 is below the regional screening level for total chromium, testing for hexavalent chromium had not been conducted at this location.

- **Preliminary Fill Soil Import Criteria – 2011**. The placement of fill materials by the landowner is occurring at the landfill to accelerate consolidation of the waste and to provide bearing capacity for future development. Guidance was developed by Geosyntec to screen fill materials accepted as Brisbane Landfill cover soil.

- **Hazardous Materials Summary Report, Brisbane Landfill – 2012**. This report was prepared by Geosyntec to summarize environmental and engineering conditions at the former landfill, and to assess whether additional environmental and/or engineering information is needed prior to the preparation of an EIR for proposed Baylands development. The study notes that of the 12.5 million cubis yards of waste material within the former landfill, an estimated 73 percent was produced by residential and commercial activities, with inert fill accounting for approximately 25 percent, and the remaining 2 percent assumed to be liquid waste. In addition, the report confirmed that waste tires were also placed in the landfill. Boring logs conducted in the area identified confirm rubber debris in the landfill.