Lease No. AYD-350

between

THE PORT AUTHORITY OF NEW YORK AND NEW JERSEY

and

JETBLUE AIRWAYS CORPORATION

Volume IV of VI

EXHIBIT 2.5

"Remedial Action Work Plan"

to Lease No. AYD-350

between

THE PORT AUTHORITY OF NEW YORK AND NEW JERSEY

and

JETBLUE AIRWAYS CORPORATION

For the Port Authority

Initialed:

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Section 1.0

September 20, 2005 Transmittal Letter

New York State Department of Environmental Conservation
Division of Environmental Remediation, Region 2
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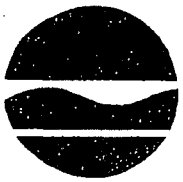

Denise M. Sheehan
Acting
Commissioner

September 20, 2005

Port Authority of New York & New Jersey
2 Gateway Center, 14th Floor
Newark, New Jersey 07102

Attn: Robert Pruno P.E., Chief Environmental Engineer

Re: Terminal 5 Expansion Remedial Action Work Plan - September 2005.

Dear Mr. Pruno:

The New York State Department of Environmental Conservation (NYSDEC) has reviewed the Remedial Action Work Plan dated September 2005 for the above referenced site. This area is within the Central Terminal Area and may be cleaned up to CTA criteria. The remedial action for the Terminal 5 is currently utilization of HiVac extraction of free product and contaminated groundwater in areas identified as 1 - 8 in the vicinity of Terminal 5. This remedial approach has significantly decreased the presence of free product on the water table around Terminal 5.

NYSDEC understands that the Port Authority of New York and New Jersey (PANYNJ) plans on entering into a long term lease with Jet Blue Airlines for Terminal 5, which includes major redevelopment of the terminal and its surrounding support infrastructure. In order to complete this construction project, the PANYNJ and Jet Blue will modify current remedial efforts and manage contaminated media during construction, then re-establish a post construction baseline to assess site conditions for remedial options.

The Terminal 5 Expansion Remedial Action Work Plan dated September 2005 has been approved, with the following conditions:

1) The John F. Kennedy International Airport - Major Petroleum Facility License (MOSF), License # 2-2380 Modification - Hydrant Fueling System Closure Plan Terminal 5 shall be approved by the NYSDEC and incorporated into this Remedial Action Work Plan.

2) The Vapor Intrusion mitigation document and model submitted to NYSDEC is still under review. The NYSDEC is conferring with NYSDOH determine if it is acceptable. The Vapor Intrusion document must be approved by NYSDEC and incorporated into this Remedial Action Work Plan.

3) A detailed construction schedule shall be forwarded to NYSDEC before any major construction or intrusive groundwork commences.

4) Documentation of Groundwater volumes treated, sampled and discharged shall be presented in the Terminal 5 Remedial Action Report. These reports shall be submitted quarterly during the construction and demolition. This report shall also document any unusual occurrences that may impact site conditions, as well as documentation of any petroleum or chemical discharges that occur during the reporting period.

5) NYSDEC reserves the right to require more aggressive remedial approaches if post construction site conditions warrant as determined by the post construction baseline.

Please notify the NYSDEC in advance of any tank removals, soil excavation and/or groundwater pumping campaigns associated with the Terminal 5 redevelopment. NYSDEC will perform frequent inspections and reserves the right to review all soil removal records and sampling results, groundwater sampling results and any air monitoring data performed during this project. If you have any questions please do not hesitate to contact me at (917) 608-1676.

Sincerely,

Michael Mulqueen
Engineering Geologist
NYSDEC Reg.2 - NYC

cc: A. Nagi, NYSDEC
K. Tang, NYSDEC
J. Koleeny, NYSDEC
T. Chen, PANYNJ
M. Moran, PANYNJ
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D. Branch, PANYNJ

File:Terminal 5 approval letter 9-19-05.wpd

Section 2.0

Terminal 5 Expansion Remedial Action Work Plan

THE PORT AUTHORITY OF NY & NJ

John F. Kennedy International Airport

TERMINAL 5 EXPANSION
REMEDIAL ACTION WORK PLAN

Port Authority of New York & New Jersey

September 2005
4907011

Prepared by:
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TERMINAL 5 REMEDIAL ACTION WORK PLAN
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MALCOLM PIRNIE, INC.
INDEPENDENT ENVIRONMENTAL ENGINEERS, SCIENTISTS & CONSULTANTS

MALCOLM PIRNIE

1.0 INTRODUCTION

Malcolm Pirnie, Inc., on behalf of the Port Authority of New York and New Jersey (PANYNJ), has prepared this Remedial Action Work Plan (RAWP) for the environmental portion of the John F. Kennedy International Airport (JFKIA) Terminal 5 Expansion. The purpose of this RAWP is to describe the remedial activities to be conducted at the site during and after the expansion of Terminal 5. Specifically, the PANYNJ plans to remove discrete pockets of free product encountered during construction activities, followed by Monitored Natural Attenuation (MNA) of the residual impacted media. The management of soil and groundwater removed during excavation activities within impacted areas will be consistent with this remedial approach.

1.1 SITE BACKGROUND

JetBlue Airways Corporation (JetBlue) has proposed to redevelop Terminal 5 and eventually include the terminal in its JFKIA operations. Terminal 5 is located within the Central Terminal Area (CTA) at JFKIA, Jamaica, Borough of Queens, New York. JFKIA is owned by the City of New York and is leased/operated by the PANYNJ. The airport is bounded on the north and west by residential areas, to the east by mixed use, and to the south by Jamaica Bay. The proposed Terminal 5 Expansion Area is composed of approximately 67 acres located within JFKIA's CTA. A site location map is provided on Figure 1.

Terminal 5 was constructed in 1962 and was previously used as a passenger terminal by Trans World Airlines (TWA). The present configuration includes a main terminal building with Flight Wing 1 to the north and Flight Wing 2 to the east of the main terminal (Figure 2). Flight Wing 1 and Flight Wing 2 will be razed as part of the Terminal 5 expansion; however, the TWA main terminal building has been designated as a historical landmark. Therefore, the TWA main terminal structure will be integrated into the expanded terminal construction with the new Terminal 5 building erected behind and connected to the historical TWA structure.

Previous investigations have identified discrete areas of free phase petroleum product and petroleum-impacted soil and groundwater within the Terminal 5 area. However, all of the contamination was located within the secure airside portion of the terminal.

1.2 SITE STRATIGRAPHY AND HYDROGEOLOGY

JFKIA lies within the Atlantic Coastal Plain Physiographic Province. This Province is characterized by relatively flat to gently undulating plains of unconsolidated sedimentary deposits. The airport is located within the southern extent of the Wisconsin glaciation in the New York/New England region. The Wisconsin glacial advances deposited a blanket of unconsolidated glacial deposits that are responsible for much of the natural topographic features of the region. The airport property exhibits little topographic relief, with an average elevation of approximately 15 feet above Mean Sea Level (MSL). The surface topography slopes gently to the south toward Jamaica Bay.

1.2.1 Geology

Previous investigations (ENSR International, May 2001) indicate that the existing Terminal 5 area is covered by asphalt or reinforced concrete tarmac up to 24-inches thick with a 6 to 12-inch gravel sub-base. Medium to fine sand fill material, ranging in

thickness from 8 to 15 feet exists beneath the sub-base. Beneath the fill material is a marsh deposit consisting of peat and organic clay/silts, generally encountered at depths of 9 to 15 feet. The peat/organic clay layer is postulated to act as a semi-confining unit between groundwater in the fill materials and groundwater beneath the peat/organic clays. However, construction operations, the installation of a basement structure under the Flight Wing 1 terminal building and the presence of former stream channels have likely resulted in discontinuities within the peat/organic layer.

1.2.2 Hydrogeology

Regional Long Island aquifers, including those in Brooklyn and Queens, are designated as "Sole Source Aquifers" by New York State Department of Environmental Conservation (NYSDEC). Public water supply in the east-central portion of Queens County is provided by a number of groundwater supply wells, which are screened in the Lloyd, Magothy, and Upper Glacial Aquifers. Four groundwater supply wells are reportedly located north of JFKIA and are screened at depths of 125 to 250 feet below the ground surface. Regional shallow groundwater generally flows to the south, toward Jamaica Bay, away from the known groundwater supply wells. Although the groundwater beneath the airport is classified as Class GA (suitable for potable purposes), groundwater in the vicinity of the airport is not used for water supply due to the limited volume and high chloride content (Camp Dresser & McKee, 1993).

Based on historic data, the depth to groundwater within the Terminal 5 area ranges from approximately 3 to 7 feet below grade and is present within the fill materials. A synoptic round of water level measurements was collected by JetBlue on December 10 and 11, 2004. A total of 77 wells were gauged during this event. The water level/elevation data (Table 1) were used to prepare water table contours shown on Figure 3. The December 10 and 11, 2004 water table contours show a general northern component of flow locally, with a mounded area to the east of Flight Wing 2 and an area of depression around Flight Wing 1. It was noted that vacuum recovery efforts east of

Flight Wing 2 were ongoing during the gauging event. The anomalous mounding effect may have been caused by these recovery efforts. The depression around Flight Wing 1 may be a result of ongoing dewatering operations around the basement of this structure.

1.3 PREVIOUS INVESTIGATIONS

In February 1996, an audit was conducted at Terminal 5 by Camp Dresser and McKee (CDM) as part of a facility-wide audit conducted at JFKIA required by the Administrative Consent Order (ACO) executed in February 1994. The audit identified compliance issues with Petroleum Bulk Storage (PBS), Chemical Bulk Storage (CBS), Water Quality Management, Air Emissions, and Hazardous Waste Management. A number of petroleum spills were also identified in the audit.

In 1998, a 3,000-gallon kerosene underground storage tank (UST) was removed from Terminal 5 and post-closure soil samples were collected. The results of the post-closure samples indicated that the levels of volatile organic compounds (VOCs) and semivolatile organic compounds (SVOCs) were below the NYSDEC STARS Memo #1 Alternative Toxicity Characteristic Leaching Procedure (TCLP) Guidance Values.

In 1999, the PANYNJ conducted an environmental site assessment at Terminal 5. The site assessment indicated the presence of elevated levels of VOCs, SVOCs, and Total Petroleum Hydrocarbons (TPHC) in the soil and groundwater. Free product was also detected in one well and two HydroPunch borings installed during the environmental site assessment.

In December 2000, United Airlines conducted a Phase I baseline investigation at Terminal 5's Flight Wing 2, in anticipation of acquiring the leasehold of a portion of the terminal. Several areas of concern were identified in the Phase I baseline investigation and subsequently further investigated as part of a Phase II baseline investigation. The results of the Phase II baseline investigation indicated the presence of several discrete free phase product plumes and dissolved petroleum contamination at Terminal 5 (ENSR

International, "Terminal 5 Flight Wing 2, Operational Area Phase II Baseline Environmental Site Assessment" May 2001).

In May 2001, the PANYNJ conducted a baseline investigation at Terminal 5's Flight Wing 1 and Building 296. The results of the baseline investigation indicated the presence of dissolved phase TPHC and VOCs in the areas of the hydrant fueling pits. No free phase product plumes were discovered during the baseline investigation at Flight Wing 1. The results of the baseline investigation also indicated the presence of MTBE and BTEX in the former fueling area. (PANYNJ, John F. Kennedy International Airport Terminal 5 Flight Wing 1, Environmental Subsurface Baseline Investigation, Final Report, July 2001).

In June and July 2001, the PANYNJ conducted a subsurface remedial investigation of Terminal 5 Flight Wing 2 and the former fueling station adjacent to Building 296. The purpose of the remedial investigation was to further delineate the extent of the free phase product plumes identified by United Airline's baseline investigation. Figure 4 shows the extent of the three free product plume areas (Areas 1 through 3) and the dissolved phase plume areas (Areas 4 through 8) identified during the United Airlines Phase II Investigation and refined during the PANYNJ remedial investigation.

The results of the remedial investigation indicated that the general area of the plumes was similar to the areas estimated by United Airlines, but the shapes were somewhat different. The results of the soil and groundwater sampling indicated that low levels of petroleum contamination exist outside of the product plumes and the level of petroleum contamination was relatively high within the product plumes (PANYNJ, John F. Kennedy International Airport Terminal 5 Flight Wing 2, Remedial Investigation, Final Report, December 2002). It should be noted that sample results with elevated method detection limits (MDLs) for benzene (e.g., greater than two times the applicable action level) were considered above the action level during the development of the

dissolved phase plume areas in the United Airlines Phase II and the PANYNJ remedial investigation.

In November and December 2004, Malcolm Pirnie Inc. conducted a baseline investigation on behalf of JetBlue. Thirty additional monitoring wells were installed in the Terminal 5 area during this investigation. Figure 5 shows the PANYNJ, United Airlines and JetBlue sampling locations in the Terminal 5 area, as well as the extent of free product based on the results of the December 2004 gauging events. Figure 5 also shows the sampling locations of three monitoring wells and three Hydropunches previously installed as part of the Terminal 6 Baseline Investigation. These sample locations are now located within the expanded lease-hold of Terminal 5. No free product has been detected within these sample locations. Dissolved phase contamination is limited to low concentrations of VOCs and TPHC in all samples except Hydropunch sample HP-18. HP-18 contained elevated VOCs and SVOCs.

1.3.1 Proposed Remediation Cleanup Goals

In a letter dated June 28, 1996, the NYSDEC accepted proposed remedial action goals (PRAGs) as cleanup criteria for select compounds in soil and groundwater at the CTA. The NYSDEC substituted cleanup criteria for the remaining compounds based on recommended soil cleanup objectives from the 1994 Technical Assistance Guidance Memorandum 4046 (TAGM 4046) prepared by the Division of Hazardous Waste Remediation, soil and groundwater criteria from draft guidance developed by the Spills Division, and groundwater criteria developed by the Division of Water. The CTA PRAGs/Cleanup Criteria (collectively referred to as the CTA Cleanup Goals) for soil and groundwater are presented in Table 2.

Soil and groundwater sample results from the previous investigations outlined above have been compared to the CTA Cleanup Goals. The historic soil and groundwater results that exceeded the CTA Cleanup Goals are shown on Figure 5. The sample results for benzene that were below the MDLs are not shown on Figure 5.

1.4 SOURCES OF CONTAMINATION

The most likely sources of the free product detected in the Terminal 5 area are the fuel hydrant related infrastructure and the fuel hydrant pits, and the maintenance vehicle refueling station south of Building 296 and possibly historical USTs. Since the fuel lines tested tight in 2000, any possible leak associated with the fuel line would have likely occurred prior to 2000. Figure 5 shows the locations of the free product plumes, as delineated by the PANYNJ and refined by JetBlue, in relation to the fuel hydrant pits and lines. The extent of free product was contoured based on the well gauging results from JetBlue conducted December 11 and 12, 2004 (Table 1) and the PANYNJ gauging event conducted October 13, 2004 (Table 3).

2.0 PRE-CONSTRUCTION REMEDIATION

Subsurface petroleum contamination at Terminal 5 has been investigated by the PANYNJ, ENSR as consultant to United Airlines, and Malcolm Pirnie Inc. on behalf of JetBlue. The petroleum impacted soil and groundwater have been delineated during these investigations. In May 2002, the PANYNJ began remedial activities in the Terminal 5 area. These activities included free product recovery from the three free product plumes in the Flight Wing 2 area. A total of 80 extraction wells were installed in the three free product plume areas for the purpose of this free product recovery program. The locations of the extraction wells, delineated free product plumes (prior to free product recovery), and other areas of elevated VOCs in soil and groundwater are shown on Figure 4.

The free product recovery program consisted of total fluids extraction from each of the extraction wells. The fluids were extracted in clusters of six to eight wells simultaneously using a vacuum truck with a drop tube and seal in each well. Initially, each cluster of extraction wells was to be pumped once every six days to allow the wells to recharge. This program continued until February 5, 2003. The product thickness was greater than 2.5 feet in some of the extraction wells prior to the initial 10 month free product recovery phase. Upon completion of this phase, the maximum product thickness was 1.54 feet in EW-70. The historic well gauging data are presented in Appendix 1.

In December 2003, a round of product/water level measurements was collected to determine the necessity of resuming the product recovery program. Based on an evaluation of product measurements, product recovery resumed in February 2004. During the free product recovery operations, the well clusters were continually monitored and adjustments were made to the frequency of the extraction cycles. The recovery efforts continued until April 30, 2004, when the maximum product thickness measured was 0.08 feet in EW-22. A total volume of 13,950 gallons of product were recovered during the 2002 through April 2004 product recovery operations.

On October 13, 2004 water level and product thickness measurements were taken from the extraction wells to re-evaluate the extent of free product. Free product recovery operations resumed again the week of December 6, 2004 and will continue until product thicknesses in all extraction wells are non-detectable or substantial construction activities are initiated (anticipated to be in the fourth quarter of 2005). Aggressive free product recovery will be employed, particularly in the vicinity of the proposed Terminal 5 footprint, prior to construction of the new building, as access to these areas will be limited after construction. The free product recovery operations will continue until all product is removed from these areas, to the extent practical, prior to construction. Monthly well gauging will continue to be used to determine free product thickness within the existing well network. Following the completion of construction, if any free product remains outside of the building footprint, free product recovery activities will continue until free product thickness is not measurable.

As discussed in Section 1.4, the most likely sources of the free product detected in the Terminal 5 area are the fuel hydrant related infrastructure and the fuel hydrant pits. Since the fuel lines tested tight in 2000, any possible leak associated with fuel lines would have likely occurred before that time. It was reported that when TWA left the site, the hydrant system was depressurized. Therefore, it is assumed that there are no on-going leaks of the hydrant system. The existing fuel hydrant lines will be properly closed prior to initiation of construction activities. A proposal for the closure of the hydrant system (including site assessment) has been be submitted to NYSDEC under separate cover.

Wells that no longer show product, but are in the historical foot print of free product (as shown on Figure 4) will be purged and groundwater recovery monitored to demonstrate that they are hydraulically connected to the aquifer.

3.0 SOIL AND GROUNDWATER MANAGEMENT DURING CONSTRUCTION ACTIVITIES

The extent of the soil and groundwater impacted above the CTA Cleanup Goals has been delineated during previous investigations. The extent of free product determined during the December 2004 gauging events and the soil and dissolved phase groundwater exceedances of the CTA Cleanup Goals are shown on Figure 5.

The current remedy at Terminal 5 consists of the recovery of discrete pockets of free product identified during the previous investigations. If pockets of free product remain following the completion of construction activities associated with the Terminal 5 expansion (i.e., additional areas of free product identified during construction/subsequent baseline investigation or portions of the current free product plumes remain), free product recovery efforts will continue until the free product is recovered to the extent practical. It is anticipated that the active free product recovery will continue until the thickness of free product is less than 0.01 feet for a period of four consecutive quarters. After the source of groundwater contamination has been removed, remedial alternatives will be evaluated for the further remediation of residual contamination within the Terminal 5 area. A monitoring program will be implemented to aid in the evaluation of the viability of monitored natural attenuation (MNA) to achieve the CTA Cleanup Goals for groundwater and institutional and engineering controls for the unsaturated soil.

The free product will be removed from the areas identified on Figure 5, to the extent practical, prior to the initiation of the Terminal 5 expansion construction activities. Construction activities associated with the decommissioning of the Fuel Hydrant System (FHS) will also be conducted consistent with this RAWP. The plan for the decommissioning of the FHS has been submitted to NYSDEC under separate cover.

The overall soil management approach during construction within the known areas of impacted soil and groundwater is to reuse the excavated soils that do not contain

free product and that meet the CTA Cleanup Goals as backfill within the Terminal 5 area. The previously delineated limits of the impacted soil and groundwater will be clearly demarcated on-site and the construction contractor(s) will be apprised that materials impacted by petroleum products may be encountered in these areas. Although caution will be taken from a health and safety standpoint, the soils from these demarcated areas that are not heavily impacted (as defined in Section 3.1) will be handled like similar soils encountered during construction at JFKIA. The impacted soils will be segregated and evaluated for potential off-site disposal or reuse onsite as backfill.

It is anticipated that approximately 30 percent of the site will be disturbed during Terminal 5 expansion construction. As shown on Figure 5, the limits of the impacted soil and groundwater are generally beyond the footprint of the proposed new terminal; however infrastructure work will occur beyond the limits of the new terminal footprint. It is anticipated that only a small percentage of the disturbed area will contain soil and groundwater impacted above CTA Cleanup Criteria requiring evaluation from an environmental standpoint. The management of impacted soil and groundwater during construction activities will be performed as outlined in Sections 3.1 and 3.2 below.

3.1 SOIL EXCAVATION/MANAGEMENT

Soils within the historical plume areas underneath the new terminal that will not be excavated as part of construction activities will be pre-classified to determine whether they contain free product and/or meet CTA Cleanup Goals. Four soil borings will be advanced and soil and groundwater screening samples collected from the southeast corner of the proposed new terminal (e.g., in the vicinity of extraction wells E-26, E-27, E-29, E-32 and E-36). Soils that are acting as a source of free product in areas where roadways or in the new terminal footprint will be excavated and removed as described in Section 3.1.1.

3.1.1 Soil Segregation Criteria

Soils generated during construction/excavation activities from the demarcated areas containing soil and groundwater above the CTA Cleanup Goals will be managed as outlined below:

1. Excavated soil will be stockpiled near the area from which it is excavated.
2. Stockpiled soil shall be visually assessed for the presence of petroleum contamination.
3. If there is no visual indication of contamination, the soil can be used as backfill on site PID evaluations will not be performed.
4. If the soil is moist from, or exhibits gross petroleum contamination, it shall be transported to a soil impoundment area for testing to evaluate if the soil concentrations meet the CTA Cleanup Goals or if the soil is to be evaluated for off site disposal. The location of these petroleum contaminated soils will be identified on a drawing with coordinates provided by a handheld GPS unit accurate to within 5 feet.
5. If discoloration in the soil is suspected to be from petroleum or chemical contamination, the soil shall be field screened with a photoionization detector (PID).
6. Soil disposition will be based on the following PID meter readings[1].
   a. Below 100 ppm - the soil may be used as backfill on site.
   b. Above 100 ppm but below 1000 ppm, soil may be backfilled in the area from which it was excavated. The location must be identified on a drawing with coordinates provided by a handheld GPS unit accurate to within 5 feet.
   c. Above 1000 ppm, the visibly stained soil in current stockpile will be sampled for CTA parameters. If soil meets CTA cleanup goals, it may be used as backfill. If not, it shall be transported to an impoundment area to be characterized for potential offsite disposal.
7. If free product is encountered in the area of the proposed building footprint, the following remedial activities will be completed:
   a. If product is leaching from the sidewall, excavate approximately five feet laterally from the sidewall to the depth of the excavation.

[1] PID readings will be measured as outlined in the Quality Assurance/Quality Control Plan (Appendix 2).

b. Remove product from the excavated area.

c. If there is no recharge by the next workday, complete required work and backfill area. If product recharged, remove product and complete required work.

Existing underground asbestos conduit shall not be removed, except as required due to construction activities.

3.1.2 Off-Site Disposal

Soil that has been segregated and transported to an impoundment area for evaluation will be stockpiled on and covered by plastic sheeting pending final disposition. Excavated soil containing free product or otherwise not meeting CTA Cleanup Goals will ultimately be transported to a treatment facility for disposal off-site in accordance with all applicable local, state and federal requirements. The number of waste characterization samples and analytical parameters required from the stockpiled soils will be determined by the disposal facility permit requirements.

Documentation of soil disposal will be presented in the Terminal 5 Remedial Action Report.

3.1.3 On-Site Re-Use of Soil

Soil that has been determined to be appropriate for on-site re-use (based on the criteria outlined above) will be stockpiled on-site separately from the segregated soil to reduce the potential for mixing. The soil will be handled in accordance with the sediment and erosion control requirements for the construction project. Storm water controls around existing catch basins will be implemented during construction activities (e.g., hay bales or silt fence around catch basins). Additionally, dust control measures will be implemented, as necessary, during construction activities to minimize airborne dust.

3.2 GROUNDWATER AND FREE PRODUCT MANAGEMENT

It is anticipated that dewatering will be required for the deeper excavation during excavation/construction activities. Water generated during the dewatering activities will be pumped into frac tanks for future waste characterization sampling and disposal. Representative waste characterization samples will be collected on a batch basis from the contents of each full frac tank to determine the options for water disposal. Water collected through dewatering efforts will be discharged into storm sewers if it meets JFKIA's State Pollution Discharge Elimination System (SPDES) permit requirements. All volumes of water discharged and the associated testing results shall be recorded on the date it was discharged. NYSDEC shall be promptly notified of exceedances of the SPDES permit parameters. The SPDES permit requirements are included in Appendix 3.

3.2.1 Off-Site Disposal

Frac tank batches containing water that exceeds the JFKIA SPDES criteria will be treated to meet the SPDES criteria and discharged into the JFKIA on-site storm sewer system or properly disposed of off-site in accordance with local, state and federal laws.

3.2.2 On-Site Storm Sewer Discharge

Frac tank batches with water that are within SPDES criteria will be discharged into the JFKIA on-site storm sewer system.

3.3 VAPOR MITIGATION

An evaluation of the potential for soil vapor intrusion at the new Terminal 5 buildings has been performed and is provided as Appendix 4. This evaluation concludes that the potential for soil vapor intrusion into the Terminal 5 building is low.

The following information, as outlined in Appendix 4, provides the weight of evidence to reach this conclusion:

1. Outdoor and indoor emissions sources of hazardous air pollutants should far outweigh soil vapor as potential contributors to indoor air quality in the Terminal 5 building. As noted above, however, indoor air quality will be controlled through the design and operation of the AHUs
2. The Terminal 5 building is designed to include a sub-slab vapor barrier and to maintain positive air pressure (of about 400 Pa) within the building. In this regard, the NYSDOH (2005) indicates that HVAC system modification – "a technique where the building's HVAC system is modified to avoid depressurization of the building relative to the underlying and surrounding soil (i.e., to maintain a positive pressure within the building") is a method of mitigating vapor intrusion. These design features, therefore, should eliminate the potential, if any, for soil vapor intrusion into the building.
3. With the exception of methylene chloride in subsurface soil, chlorinated hydrocarbons were not detected in groundwater or subsurface soil underlying or within 100 feet horizontally of the Terminal 5 building footprint. Petroleum hydrocarbons, which were the predominant detected chemicals, are generally less toxic and more amenable to biodegradation in the environment.
4. The Johnson & Ettinger (J&E) modeling analyses indicates that chemical concentrations in groundwater and subsurface soil underlying or within 100 feet horizontally of the Terminal 5 building footprint are low enough to not pose a vapor intrusion hazard. For many of the chemicals, the modeling analyses indicated "not of concern", meaning that the predicted groundwater or subsurface soil concentrations protective of the prescribed target risk levels would be greater than their water solubility limit or soil saturation concentration. For the other chemicals, the predicted groundwater or subsurface soil concentrations protective of the prescribed target risk levels are orders of magnitude greater than detected concentrations in those environmental media.

4.0 POST-CONSTRUCTION INVESTIGATION AND REMEDIATION

Free product recovery will continue after the completion of the Terminal 5 construction activities, as necessary. Any previously delineated free product plumes and plumes discovered during construction/subsequent investigation that still contain recoverable quantities of free product will be targeted for post-construction remediation. In addition, a post-construction evaluation will be performed and, based on the data, a remedial alternative will be selected. It is anticipated that a monitoring program will be implemented for the documentation of viability of MNA of groundwater at Terminal 5.

Soils containing residual contamination exceeding the CTA Cleanup Goals are anticipated to naturally attenuate as well. Beyond any natural attenuation that may occur, the remedial alternative for the impacted soil in the unsaturated zone will consist of Engineering and Institutional Controls as outlined in Section 4.2.

4.1 ESTABLISHMENT OF POST-CONSTRUCTION BASELINE

After completion of the construction activities, new monitoring wells will be installed at the site to document the post-construction baseline conditions. The well locations will be selected after completion of construction activities and will target the areas which are anticipated to contain soil and groundwater impacts based on historic investigation activities and conditions observed and evaluated during construction.

Post-construction soil samples will be collected from the borings prior to conversion into monitoring wells. Two soil samples will be collected from each boring, one soil sample between one to two feet bgs and one within the smear zone above the water table. If soil screening indicates that the soil at another depth other than the two

above samples has the highest PID reading, then one additional soil sample will be collected from this depth. The soil analytical results will be used to verify post-construction baseline conditions and to aid in the evaluation of potential continuing impact to groundwater sources. After well installation, one round of groundwater samples will be collected from the wells to assess the post-construction nature and extent of dissolved phase contamination in the vicinity of the Terminal 5 Expansion Area. A complete gauging event will also be performed on the existing wells to document the extent of free product after construction activities. During this baseline sampling event, groundwater and soil samples will be collected and analyzed for the Priority Pollutant list of 126 compounds and elements developed by the Environmental Protection Agency (EPA) pursuant to Section 307(a)(1) of the Clean Water Act and 40 non-targeted organic compounds detected by gas chromatography/mass spectroscopy (GC/MS) analysis, Total Xylenes, Methyl Tertiary Butyl Ether (MTBE), Tert-Bytyl Alcohol (TBA), Total Glycol and Total Petroleum Hydrocarbons (TPHC). All analyses will be performed by laboratories certified by the New York State Department of Health (NYSDOH) under the Environmental Laboratory Accreditation Program (ELAP).

A second round of post-construction groundwater samples will be collected within three to six months of the baseline sample event. Samples will be collected from up to ten monitoring wells which the baseline results indicate contain groundwater contamination to verify/further evaluate existing conditions and establish contaminant reduction trends.

Groundwater samples will be collected using USEPA Low-Flow purging and sampling procedures. Field indicator parameters (including pH, temperature, oxidation-reduction potential, specific conductance, turbidity and dissolved oxygen) will also be documented during purging and sampling. Data generated from the baseline sampling event will be presented to the NYSDEC in the Terminal 5 Remedial Action Report. The baseline sampling section of the report will include a discussion of the groundwater sampling event and the extent of free phase, if any, and dissolved phase contamination in

the Terminal 5 area after construction activities are completed. The report will also include recommendations for additional free product recovery efforts (if needed) and a schedule for initiating an MNA study at the site. If substantial additional free product recovery is not required after construction of the Terminal 5 Expansion Area, the initial MNA sampling (as described in Section 4.3) will be performed concurrently with the baseline groundwater sampling described above.

4.2 POST-CONSTRUCTION REMEDIATION

After construction, any areas outside of the new Terminal 5 building footprint which still contain recoverable free product will be the main focus of active remediation which will consist of product recovery as described in Section 2.0. The product recovery program, will resume after the construction activities, to continue removing any free product in the Terminal 5 area.

4.2.1 Groundwater Remediation

MNA is the presumed remedy for the impacted groundwater at the site, as it is cost effective, permanent and protective of human health and the environment. The viability of MNA to remediate the groundwater to achieve CTA Cleanup Goals will be determined as outlined in Section 4.3.

4.2.2 Soil Remediation

Beyond the natural attenuation that will occur in the soil, the remedial alternative for the impacted soil in the unsaturated zone will consist of Engineering and Institutional Controls.

4.2.2.1 Engineering Controls

The impacted area will be capped by the newly constructed terminal and paved ramp area. The cap will effectively minimize the infiltration of precipitation, control runoff and minimize the potential exposure pathways for incidental soil ingestion, soil

and water dermal contact, and particulate inhalation. These engineering controls will be maintained as part of the routine terminal maintenance. Due to the rigorous maintenance requirements for the terminal, additional inspections beyond routine terminal inspections will not be performed and annual reporting of the integrity of the capped areas is not anticipated to be required.

4.2.2.2 Institutional Controls

The following institutional controls are in place, which limit the potential exposure to the public from residual contaminants: The above-referenced ACO is in effect for the JFKIA Central Terminal Area.

4.2.2.3 Future Construction/Maintenance/Remediation Activities

Future construction activities will include provisions required for future development, remediation, or maintenance activities requiring subsurface excavation of soil or extraction of groundwater. Any future work that results in the disposal of soil or groundwater within the leasehold of this site is the responsibility of the tenant unless the work is being performed by the PANYNJ or their contractors. All tenant work is reviewed and approved by the PANYNJ prior to commencement. Plan preparation for these activities will assure compliance with NYSDEC/NYSDOH approved site-specific health and safety, community air monitoring, and operation monitoring and maintenance plans, as applicable.

5.0 MONITORED NATURAL ATTENUATION EVALUATION

Free product recovery efforts will continue until the free product is recovered to the extent practical (i.e., until the point of diminishing returns is reached). It is anticipated that the active free product recovery will continue until the thickness of free product is less than 0.01 feet for a period of four consecutive quarters. After the source of groundwater contamination has been removed, a monitoring program will then be implemented to aid in the evaluation of viability of MNA for the site.

5.1 MNA STUDY

A groundwater monitoring program will be implemented to monitor plume characteristics, movement, and related controlling processes, to obtain data for estimating the eventual extent of the plume, and to assess the effectiveness of the MNA remedy. In accordance with the NYSDEC Draft DER-10 Technical Guidance, the following elements will be included in the program.

5.1.1 Groundwater Velocity Determination

In-situ slug tests will be performed on a minimum of six representative monitoring wells across the site to determine the hydraulic conductivity locally. Water level measurements will also be collected and a revised water table contour map prepared and hydraulic gradient calculated. This work will be completed to facilitate the calculation of groundwater seepage velocity at the site after the construction activities have been completed. The calculated seepage velocity will be used to determine placement of the MNA sentinel monitoring wells [e.g., beyond three years' groundwater travel time from the delineated downgradient extent of the contaminant plume(s)]. The groundwater velocity determination evaluation will be performed as soon as practical after the dewatering operations of existing Flight Wing 1 have ceased.

5.1.2 MNA Monitoring Well Network

The MNA monitoring well network will be installed/identified after the product recovery efforts and groundwater velocity determination are completed. Existing monitoring wells and extraction wells will be used, as appropriate. Additional wells may be required to augment the well network in order to achieve the goals of the MNA Study. The MNA monitoring network will include the following:

- One or more monitoring wells located upgradient of the impacted areas;
- One or more monitoring wells located within the current free product areas to monitor plume conditions at the source areas;
- Two plume monitoring wells located immediately downgradient of the source area(s), but within the contaminant plume(s);
- Two plume fringe monitoring wells located at the limit of the plume(s), defined as an area where contaminant concentrations are below CTA Cleanup Goals; and
- Two down gradient sentinel wells located beyond the zone of groundwater exceeding CTA Cleanup Goals. Contaminant levels in the sentinel wells must remain below the applicable standards for MNA to be considered effective. The sentinel wells will be located approximately three years travel time of groundwater to the nearest potential down-gradient receptor (e.g., leasehold property line) and five years travel time from the delineated down-gradient extent of the contaminant plume.

After installation of the MNA monitoring network, as described above, one synoptic round of water level measurements will be collected to refine the understanding of local hydrogeologic regime (e.g., groundwater flow direction and seepage velocity) and to determine whether additional monitoring wells are needed to achieve the goals of the MNA Study. At least one downgradient sampling point will be located at the centerline of the plume.

5.1.3 MNA Viability Determination

Soil and groundwater samples will be collected to establish baseline conditions and to aid in the initial determination of the viability of MNA at the site. Soil samples

will be collected during the soil boring/monitoring well installations. The soil samples will be collected from the saturated zone for analyses of baseline STARS VOCs and SVOCs, TPHC, nutrients and bacterial plate counts within the aquifer matrix. As outlined in Section 4.1, additional soil samples will also be collected from the post-construction baseline borings within and above the smear zone to determine whether any potential continuing impact to groundwater sources may be present. These data will be used in the evaluation of the viability of MNA at the site.

A groundwater sample will be collected from each well in the MNA monitoring network to establish baseline conditions. Groundwater samples will be collected using the USEPA Low-Flow purging and sampling procedures. Field indicator parameters (including pH, temperature, oxidation-reduction potential, specific conductance, salinity, turbidity and dissolved oxygen) will also be documented during purging and sampling.

Groundwater samples collected as part of the baseline MNA sampling event will be analyzed for STARS VOCs and SVOCs, TPHC, alkalinity, sulfates, nitrate, ferrous iron, dissolved iron and manganese. Groundwater samples will be collected and analyzed in accordance with the Quality Assurance/Quality Control Plan provided as Appendix 2. The parameter list may be reduced for subsequent sampling events based on the initial MNA data and the water quality data.

If MNA is determined to be non viable at the site, the PANYNJ will evaluate other remedial alternatives.

5.1.4 MNA Study Sample Frequency and Reporting

If the baseline data suggest that the residual contamination at the site may effectively naturally attenuate, then a MNA Study will be performed. The MNA Study will consist of a quarterly groundwater sampling program to be implemented over a two year period. It is anticipated that the samples will be analyzed for the same parameters as the baseline samples for groundwater.

The MNA data will be evaluated after one year to determine whether the concentrations of contamination are decreasing, to identify biodegradation rate-limiting parameters (e.g., nutrients) and to determine whether adjustments need to be made. After eight quarters of monitoring, a MNA Study Report will be prepared. The MNA Study Report will include a thorough analysis of the data including rate constants, trend analysis, determination of redox zonation and a summary of seepage velocity and hydraulic gradient. The contaminant trend and nutrient analyses will also be summarized. These parameters will be used to estimate the distance of plume stabilization and time of remediation for the contaminants to attenuate to below CTA Cleanup Goals (or applicable groundwater criteria).

After the MNA Study is submitted to the NYSDEC, PANYNJ and NYSDEC will determine if additional monitoring is warranted. If it is determined that additional monitoring is warranted, then the number of wells to be sampled, parameters; and frequency of sample collection will be proposed by PANYNJ. The revised MNA program, if needed, will be implemented by the PANYNJ after approval by NYSDEC.

PANYNJ will conduct post MNA sampling to demonstrate that CTA Cleanup Goals (or applicable groundwater criteria) have been met.

6.0 SCHEDULE

The free product recovery remediation efforts at the Terminal 5 site are currently ongoing. The free product recovery program will continue until the product levels in the extraction wells are non-detectable or until substantial construction activities are initiated, making it impractical to continue. It is anticipated that construction activities will begin the fourth quarter of 2005 and last until 2008, at which time the post-construction sampling will be performed. Free product recovery efforts will also be resumed after construction has been completed, if necessary. The MNA Study will be initiated after construction and free product recovery activities have been completed.

7.0 REFERENCES

Department of Environmental Conservation, 2002. Draft DER-10 Technical Guidance for Site Investigation and Remediation. December 2002.

ENSR International, 2001. Terminal 5 Flight Wing, Operational Area Phase II Baseline Environmental Site Assessment. May 2001.

The Port Authority of NY & NJ – Engineering Department, 2001. Environmental Subsurface Baseline Investigation. Final Report. July 2001.

The Port Authority of NY & NJ – Engineering Department, 2002. Remedial Investigation. Final Report. December 2002.

Camp, Dresser and McKee, 1996. Comprehensive Environmental Compliance Audit Exit Interview Summary. Final. February 1996.

EXEMPTION (4) – DRAWINGS OF NON-PUBLIC AREAS

APPENDICES

APPENDIX 1

Historic Well Gauging Data

Table 2
Terminal 5 Progress Monitoring
Groundwater Elevations and Product Thickness

Well ID:	Date:	DTP feet (ftbc)	DTW feet (ftbc)	Product Thickness (ft)
EW-1	5/15/2002	6.14	6.26	0.12
	11/15/2002		6.12	0.00
	1/31/2003		5.75	0.00
	12/3/2003		5.72	0.00
	3/8/2004		5.74	0.00
	5/28/2004		5.15	0.00
	6/29/2004		5.14	0.00
	8/3/2004		5.14	0.00
	9/2/2004		5.28	0.00
	10/13/2004		5.45	0.00
	11/12/2004		5.75	0.00
	1/31/2005		5.34	0.00
	3/24/2005		5.39	0.00
	4/18/2005		5.41	0.00
				0.00
				0.00
				0.00
				0.00
				0.00
EW-2	5/15/2002	5.67	5.82	0.15
	11/15/2002		5.79	0.00
	1/31/2003	5.35	5.36	0.01
	12/3/2003	5.18	5.21	0.03
	2/5/2004		5.41	0.00
	5/28/2004		4.60	0.00
	6/29/2004		4.58	0.00
	8/3/2004		4.58	0.00
	9/2/2004		4.75	0.00
	10/13/2004		4.58	0.00
	11/12/2004		5.13	0.00
	1/31/2005	4.89	4.99	0.10
	3/24/2005	4.91	4.92	0.01
	4/18/2005	4.80	4.92	0.12
				0.00
				0.00
				0.00
				0.00
				0.00
EW-3	5/15/2002		5.67	0.00
	12/3/2003		5.15	0.00
	2/5/2004		5.44	0.00
	3/8/2004		5.29	0.00
	4/27/2004		4.85	0.00
	5/28/2004		4.50	0.00
	6/29/2004		4.51	0.00
	8/3/2004		4.52	0.00
	9/2/2004		4.67	0.00

Table 2
Terminal 5 Progress Monitoring
Groundwater Elevations and Product Thickness

Well ID:	Date:	DTP feet (ftbc)	DTW feet (ftbc)	Product Thickness (ft)
	10/13/2004		4.83	0.00
	11/12/2004		5.09	0.00
	1/31/2005		4.9	0.00
	3/24/2005		4.9	0.00
	4/18/2005		4.91	0.00
				0.00
				0.00
				0.00
				0.00
				0.00
EW-4	5/15/2002	6.14	7.43	1.29
	11/15/2002	6.26	6.53	0.27
	1/13/2003		5.78	0.00
	12/3/2003	5.92	5.93	0.01
	2/5/2004		6.10	0.00
	5/28/2004		5.32	0.00
	6/29/2004		5.31	0.00
	8/3/2004		5.32	0.00
	9/2/2004		5.46	0.00
	10/13/2004		5.51	0.00
	11/12/2004		5.78	0.00
	1/31/2005		5.21	0.00
	3/24/2005		5.58	0.00
	4/18/2005		5.7	0.00
				0.00
				0.00
				0.00
				0.00
				0.00
EW-5	5/15/2002		6.29	0.00
	11/15/2002		6.17	0.00
	1/31/2003		5.89	0.00
	12/3/2003	5.77	5.78	0.01
	2/5/2004		5.95	0.00
	5/28/2004		5.17	0.00
	6/29/2004		5.02	0.00
	8/3/2004		5.16	0.00
	9/2/2004		5.32	0.00
	10/13/2004		5.47	0.00
	11/12/2004		5.74	0.00
	1/31/2005		5.46	0.00
	3/24/2005		5.33	0.00
	4/18/2005		5.35	0.00
				0.00
				0.00
				0.00
				0.00

Table 2
Terminal 5 Progress Monitoring
Groundwater Elevations and Product Thickness

Well ID:	Date:	DTP feet (ftbc)	DTW feet (ftbc)	Product Thickness (ft)
				0.00
EW-6	5/15/2002	6.20	6.30	0.10
	12/3/2003		5.55	0.00
	2/5/2004		5.77	0.00
	3/8/2004		5.66	0.00
	4/27/2004		5.36	0.00
	5/28/2004		4.96	0.00
	6/29/2004		4.97	0.00
	8/3/2004		4.97	0.00
	9/2/2004		5.12	0.00
	10/13/2004		5.23	0.00
	11/12/2004		5.51	0.00
	1/31/2005		5.26	0.00
	3/24/2005		5.3	0.00
	4/18/2005		5.44	0.00
				0.00
				0.00
				0.00
				0.00
				0.00
EW-7	5/15/2002	5.94	5.95	0.01
	12/3/2003	5.41	5.43	0.02
	2/5/2004		5.86	0.00
	3/8/2004		5.56	0.00
	4/27/2004		5.20	0.00
	5/28/2004		3.00	0.00
	6/29/2004		4.83	0.00
	8/3/2004		4.83	0.00
	9/2/2004		5.00	0.00
	10/13/2004		5.18	0.00
	11/12/2004		5.42	0.00
	1/31/2005		5.20	0.00
	3/24/2005		5.21	0.00
	4/18/2005		5.11	0.00
				0.00
				0.00
				0.00
				0.00
				0.00
EW-8	5/13/2002		6.91	0.00
	11/15/2002		6.91	0.00
	1/31/2003	6.00	6.23	0.23
	12/3/2003		6.53	0.00
	3/8/2004		6.56	0.00
	5/28/2004		5.93	0.00
	6/29/2004		5.83	0.00
	8/3/2004		5.91	0.00

Table 2
Terminal 5 Progress Monitoring
Groundwater Elevations and Product Thickness

Well ID:	Date:	DTP feet (ftbc)	DTW feet (ftbc)	Product Thickness (ft)
	9/2/2004		6.09	0.00
	10/13/2004		6.21	0.00
	11/12/2004		6.41	0.00
	1/31/2005		6.11	0.00
	3/24/2005		6.19	0.00
	4/18/2005		6.11	0.00
				0.00
				0.00
				0.00
				0.00
				0.00
EW-9	5/13/2002		6.33	0.00
	11/15/2002	6.21	6.81	0.60
	1/31/2003	6.00	6.23	0.23
	12/3/2003	5.80	7.10	1.30
	2/9/2004	6.00	6.60	0.60
	3/8/2004	6.01	6.10	0.09
	4/27/2004		5.77	0.00
	5/28/2004		5.34	0.00
	6/29/2004		5.38	0.00
	8/3/2004		5.36	0.00
	9/2/2004		5.6	0.00
	10/13/2004	5.59	5.84	0.25
	11/12/2004		6.34	0.00
	1/31/2005	5.54	6.03	0.49
	3/24/2005	6.60	6.63	0.03
	4/18/2005		5.92	0.00
				0.00
				0.00
				0.00
				0.00
				0.00
EW-10	5/3/2002	5.80	7.94	2.14
	11/12/2002	6.04	6.39	0.35
	2/3/2003	5.92	5.93	0.01
	12/3/2003	5.63	6.24	0.61
	2/9/2004	5.70	6.70	1.00
	3/8/2004	5.91	5.92	0.01
	4/27/2004		5.57	0.00
	5/28/2004		5.14	0.00
	6/29/2004		4.81	0.00
	8/3/2004		5.20	0.00
	9/2/2004		5.31	0.00
	10/13/2004		5.42	0.00
	11/12/2004		6.12	0.00
	1/31/2005		5.45	0.00
	3/24/2005		5.51	0.00

Table 2
Terminal 5 Progress Monitoring
Groundwater Elevations and Product Thickness

Well ID:	Date:	DTP feet (ftbc)	DTW feet (ftbc)	Product Thickness (ft)
	4/18/2005		5.33	0.00
				0.00
				0.00
				0.00
				0.00
				0.00
EW-11	5/3/2002		5.78	0.00
	12/3/2003	5.15	6.02	0.87
	2/9/2004	5.40	6.40	1.00
	3/8/2004	5.51	5.52	0.01
	4/27/2004		5.09	0.00
	5/28/2004		4.74	0.00
	6/29/2004	4.61	4.85	0.24
	8/3/2004	4.71	5.15	0.44
	9/2/2004	4.82	5.32	0.50
	10/13/2004	4.80	5.23	0.43
	11/12/2004	5.19	5.75	0.56
	1/31/2005		5.13	0.00
	3/24/2005		6.15	0.00
	4/18/2005		6.15	0.00
				0.00
				0.00
				0.00
				0.00
				0.00
EW-12	5/13/2002	6.61	8.89	2.28
	11/12/2002	6.77	8.17	1.40
	2/3/2003		6.61	0.00
	12/3/2003	6.48	7.70	1.22
	2/9/2004		6.60	0.00
	3/8/2004		6.63	0.00
	4/27/2004		6.38	0.00
	5/28/2004		6.00	0.00
	6/29/2004		5.95	0.00
	8/3/2004		5.99	0.00
	9/2/2004		6.15	0.00
	10/13/2004		6.25	0.00
	11/12/2004		6.52	0.00
	3/24/2005		6.23	0.00
	4/18/2005		6	0.00
				0.00
				0.00
				0.00
				0.00
				0.00
				0.00
EW-13	5/21/2002	6.88	6.95	0.07

Table 2
Terminal 5 Progress Monitoring
Groundwater Elevations and Product Thickness

Well ID:	Date:	DTP feet (ftbc)	DTW feet (ftbc)	Product Thickness (ft)
	11/18/2002	6.67	7.70	1.03
	2/3/2003	6.47	6.61	0.14
	12/3/2003	6.25	7.30	1.05
	2/9/2004	6.40	7.30	0.90
	3/8/2004	6.46	6.87	0.41
	4/27/2004		6.24	0.00
	5/28/2004		5.78	0.00
	6/29/2004		5.80	0.00
	8/3/2004		5.81	0.00
	9/2/2004		5.03	0.00
	10/13/2004		6.10	0.00
	11/12/2004		6.37	0.00
	1/31/2005		6.05	0.00
	3/24/2005	6.09	6.1	0.01
	4/18/2005	5.92	5.95	0.03
				0.00
				0.00
				0.00
				0.00
				0.00
EW-14	5/3/2002		6.18	0.00
	11/12/2002	5.64	6.85	1.21
	2/3/2003	5.76	6.59	0.83
	1/3/2003	5.60	6.41	0.81
	2/9/2004	5.80	6.40	0.60
	3/8/2004	5.84	6.30	0.46
	4/27/2004		5.64	0.00
	5/28/2004		5.15	0.00
	6/29/2004		5.10	0.00
	8/3/2004		5.19	0.00
	9/2/2004		5.32	0.00
	10/13/2004		5.43	0.00
	11/12/2004		5.78	0.00
	1/31/2005		5.47	0.00
	3/24/2005		5.5	0.00
	4/18/2005		5.32	0.00
				0.00
				0.00
				0.00
				0.00
				0.00
EW-15	5/3/2002		5.28	0.00
	12/3/2003		4.82	0.00
	3/8/2004		4.93	0.00
	4/27/2004		4.55	0.00
	5/28/2004		4.15	0.00
	6/29/2004		4.13	0.00

Table 2
Terminal 5 Progress Monitoring
Groundwater Elevations and Product Thickness

Well ID:	Date:	DTP feet (ftbc)	DTW feet (ftbc)	Product Thickness (ft)
	8/3/2004		4.26	0.00
	9/2/2004		4.38	0.00
	10/13/2004		4.61	0.00
	11/12/2004		4.73	0.00
	1/31/2005		4.54	0.00
	3/24/2005		4.6	0.00
	4/18/2005		4.77	0.00
				0.00
				0.00
				0.00
				0.00
				0.00
EW-16	5/13/2002	6.53	6.79	0.26
	11/18/2002	6.64	6.82	0.18
	2/3/2003		7.15	0.00
	12/3/2003	6.30	6.95	0.65
	2/10/2004		6.40	0.00
	4/27/2004		6.13	0.00
	5/28/2004		5.75	0.00
	6/29/2004		5.72	0.00
	8/3/2004		4.75	0.00
	9/2/2004		5.93	0.00
	10/13/2004		6.02	0.00
	11/12/2004	6.20	6.21	0.01
	1/31/2005		6	0.00
	3/24/2005		6.05	0.00
	4/18/2005		6.01	0.00
				0.00
				0.00
				0.00
				0.00
				0.00
EW-17	5/3/2002	5.47	7.75	2.28
	11/12/2002	5.59	6.55	0.96
	2/3/2003	5.51	6.05	0.54
	12/3/2003	5.32	5.60	0.28
	2/10/2004	5.50	6.00	0.50
	3/8/2004	5.50	5.76	0.26
	4/27/2004		5.19	0.00
	5/28/2004		4.81	0.00
	6/29/2004		4.84	0.00
	8/3/2004		4.83	0.00
	9/2/2004		5.01	0.00
	10/13/2004		4.81	0.00
	11/12/2004		5.39	0.00
	1/31/2005		5.12	0.00
	3/24/2005		5.15	0.00

Table 2
Terminal 5 Progress Monitoring
Groundwater Elevations and Product Thickness

Well ID:	Date:	DTP feet (ftbc)	DTW feet (ftbc)	Product Thickness (ft)
	4/18/2005		5.2	0.00
				0.00
				0.00
				0.00
				0.00
				0.00
EW-18	5/3/2002		5.20	0.00
	11/13/2002		5.13	0.00
	2/4/2003	4.92	4.93	0.01
	12/3/2003		4.72	0.00
	3/8/2004		5.91	0.00
	5/28/2004		4.15	0.00
	6/29/2004		4.30	0.00
	8/3/2004		4.22	0.00
	9/2/2004		4.39	0.00
	10/13/2004		4.50	0.00
	11/12/2004		4.79	0.00
	1/31/2005		4.5	0.00
	3/24/2005		4.53	0.00
	4/18/2005		4.48	0.00
				0.00
				0.00
				0.00
				0.00
				0.00
EW-19	5/2/2002	5.90	7.71	1.81
	11/13/2002	6.25	6.48	0.23
	2/4/2003	5.91	5.92	0.01
	12/3/2003	5.81	6.00	0.19
	2/10/2004		5.90	0.00
	3/8/2004	5.90	5.91	0.01
	4/27/2004		5.60	0.00
	5/28/2004		5.25	0.00
	6/29/2004		5.30	0.00
	8/3/2004		5.25	0.00
	9/2/2004	5.41	5.42	0.01
	10/13/2004		5.61	0.00
	11/12/2004		5.81	0.00
	1/31/2005		5.51	0.00
	3/24/2005		5.51	0.00
	4/18/2005		5.5	0.00
				0.00
				0.00
				0.00
				0.00
				0.00
EW-20	5/2/2002	5.30	7.00	1.70

Table 2
Terminal 5 Progress Monitoring
Groundwater Elevations and Product Thickness

Well ID:	Date:	DTP feet (ftbc)	DTW feet (ftbc)	Product Thickness (ft)
	11/13/2002	6.58	6.95	0.37
	2/4/2003	5.37	5.38	0.01
	12/3/2003	5.20	5.45	0.25
	2/10/2004	5.30	5.40	0.10
	3/8/2004		5.57	0.00
	4/27/2004	4.98	5.03	0.05
	5/28/2004		4.60	0.00
	6/29/2004	4.61	4.63	0.02
	8/3/2004	4.67	4.71	0.04
	9/2/2004	4.80	4.99	0.19
	10/13/2004	4.14	5.05	0.91
	11/12/2004	5.22	5.35	0.13
	1/31/2005	4.95	4.96	0.01
	3/24/2005		4.99	0.00
	4/18/2005		4.96	0.00
				0.00
				0.00
				0.00
				0.00
				0.00
EW-21	5/2/2002		5.31	0.00
	11/13/2002		5.31	0.00
	2/4/2003		5.70	0.00
	12/3/2003	4.85	5.32	0.47
	2/10/2004		5.00	0.00
	3/8/2004	5.06	5.07	0.01
	4/27/2004		4.69	0.00
	5/28/2004		4.25	0.00
	6/29/2004		4.40	0.00
	8/3/2004		4.41	0.00
	9/2/2004		4.51	0.00
	10/13/2004		4.71	0.00
	11/12/2004		4.99	0.00
	1/31/2005		4.69	0.00
	3/24/2005		4.72	0.00
	4/18/2005		4.66	0.00
				0.00
				0.00
				0.00
				0.00
				0.00
EW-22	5/2/2002	5.29	6.03	0.74
	11/13/2002	5.97	6.18	0.21
	2/4/2003	5.87	5.88	0.01
	12/3/2003	5.58	6.00	0.42
	2/10/2004		5.70	0.00
	3/8/2004		5.77	0.00

Table 2
Terminal 5 Progress Monitoring
Groundwater Elevations and Product Thickness

Well ID:	Date:	DTP feet (ftbc)	DTW feet (ftbc)	Product Thickness (ft)
	4/27/2004	5.33	5.41	0.08
	5/28/2004		5.00	0.00
	6/29/2004	5.02	5.10	0.08
	8/3/2004	4.99	5.45	0.46
	9/2/2004	5.09	5.84	0.75
	10/13/2004	5.23	5.63	0.40
	11/12/2004	5.59	5.73	0.14
	1/31/2005	5.26	5.5	0.24
	3/24/2005	5.32	5.91	0.59
	4/18/2005	5.18	5.36	0.18
				0.00
				0.00
				0.00
				0.00
				0.00
EW-23	5/2/2002	5.01	5.92	0.91
	11/13/2002	5.91	6.90	0.99
	2/4/2003	5.85	5.86	0.01
	12/3/2003	5.50	5.60	0.10
	2/10/2004		5.70	0.00
	3/8/2004		5.70	0.00
	4/27/2004		5.29	0.00
	5/28/2004		4.97	0.00
	6/29/2004		5.03	0.00
	8/3/2004		5.05	0.00
	9/2/2004		5.22	0.00
	10/13/2004		5.31	0.00
	11/12/2004		5.6	0.00
	1/31/2005		5.27	0.00
	3/24/2005		5.34	0.00
	4/18/2005		5.22	0.00
				0.00
				0.00
				0.00
				0.00
				0.00
EW-24	5/2/2002		6.03	0.00
	12/3/2003		5.59	0.00
	3/8/2004		5.75	0.00
	4/27/2004	5.31	5.32	0.01
	5/28/2004		4.97	0.00
	6/29/2004		4.90	0.00
	8/3/2004		5.08	0.00
	9/2/2004		5.3	0.00
	10/13/2004		5.25	0.00
	11/12/2004		5.71	0.00
	1/31/2005		5.32	0.00

Table 2
Terminal 5 Progress Monitoring
Groundwater Elevations and Product Thickness

Well ID:	Date:	DTP feet (ftbc)	DTW feet (ftbc)	Product Thickness (ft)
	3/24/2005		5.34	0.00
	4/18/2005		5.23	0.00
				0.00
				0.00
				0.00
				0.00
				0.00
EW-25	5/2/2002		5.80	0.00
	12/3/2003		5.28	0.00
	3/8/2004		5.51	0.00
	4/27/2004		5.12	0.00
	5/28/2004		4.80	0.00
	6/29/2004		4.89	0.00
	8/3/2004		4.87	0.00
	9/2/2004		5.04	0.00
	10/13/2004		5.18	0.00
	11/12/2004		5.44	0.00
	1/31/2005		5.1	0.00
	3/24/2005		5.16	0.00
	4/18/2005		5.18	0.00
				0.00
				0.00
				0.00
				0.00
				0.00
EW-26	5/1/2002	6.79	8.38	1.59
	11/14/2002	6.93	7.10	0.17
	2/5/2003		6.63	0.00
	12/3/2003	6.67	6.69	0.02
	3/8/2004		6.74	0.00
	5/28/2004		6.17	0.00
	6/29/2004		6.00	0.00
	8/3/2004		6.15	0.00
	9/2/2004		6.28	0.00
	10/13/2004		6.37	0.00
	11/12/2004		6.64	0.00
	1/31/2005		6.32	0.00
	3/24/2005		6.3	0.00
	4/18/2005		6.19	0.00
				0.00
				0.00
				0.00
				0.00
				0.00
EW-27	5/1/2002		7.02	0.00
	12/3/2003		6.60	0.00
	3/8/2004		6.77	0.00

Table 2
Terminal 5 Progress Monitoring
Groundwater Elevations and Product Thickness

Well ID:	Date:	DTP feet (ftbc)	DTW feet (ftbc)	Product Thickness (ft)
	4/27/2004		6.45	0.00
	5/28/2004		6.12	0.00
	6/29/2004		6.17	0.00
	8/3/2004		6.12	0.00
	9/2/2004		6.28	0.00
	10/13/2004		6.46	0.00
	11/12/2004		6.66	0.00
	1/31/2005		6.35	0.00
	3/24/2005		6.28	0.00
	4/18/2005		6.25	0.00
				0.00
				0.00
				0.00
				0.00
				0.00
EW-28	5/9/2002	6.92	8.04	1.12
	11/14/2002	6.96	7.20	0.24
	2/5/2003		6.64	0.00
	12/3/2003	6.67	6.95	0.28
	2/11/2004	6.60	6.80	0.20
	3/8/2004		6.71	0.00
	4/27/2004		6.43	0.00
	5/28/2004		6.11	0.00
	6/29/2004		6.13	0.00
	8/3/2004		6.18	0.00
	9/2/2004	5.25	5.27	0.02
	10/13/2004	6.36	6.41	0.05
	11/12/2004	6.65	6.67	0.02
	1/31/2005		7.31	0.00
	3/24/2005		6.32	0.00
	4/18/2005	6.11	6.33	0.22
				0.00
				0.00
				0.00
				0.00
				0.00
EW-29	5/1/2002	6.87	9.31	2.44
	11/14/2002	7.19	7.54	0.35
	2/5/2003	6.88	6.94	0.06
	12/3/2003	6.81	7.63	0.82
	2/11/2004	6.90	7.10	0.20
	3/8/2004	6.84	7.28	0.44
	4/27/2004		7.70	0.00
	6/29/2004		6.29	0.00
	8/3/2004		6.41	0.00
	9/2/2004		6.55	0.00
	10/13/2004		6.65	0.00

Table 2
Terminal 5 Progress Monitoring
Groundwater Elevations and Product Thickness

Well ID:	Date:	DTP feet (ftbc)	DTW feet (ftbc)	Product Thickness (ft)
	11/12/2004	6.80	7.54	0.74
	1/31/2005	6.55	6.56	0.01
	3/24/2005	6.55	6.73	0.18
	4/18/2005		6.22	0.00
				0.00
				0.00
				0.00
				0.00
				0.00
EW-30	5/9/2002	6.73	8.94	2.21
	11/14/2002	6.83	7.64	0.81
	2/5/2003	6.56	7.05	0.49
	12/3/2003	6.55	7.01	0.46
	2/11/2004	6.50	6.80	0.30
	3/8/2004	6.61	6.65	0.04
	4/27/2004		6.41	0.00
	5/28/2004		6.06	0.00
	6/29/2004		5.95	0.00
	8/3/2004		6.11	0.00
	9/2/2004		6.24	0.00
	10/13/2004		6.29	0.00
	11/12/2004	6.59	6.89	0.30
	1/31/2005		6.22	0.00
	3/24/2005		6.28	0.00
	4/18/2005		6.23	0.00
				0.00
				0.00
				0.00
				0.00
				0.00
EW-31	5/9/2002	6.59	8.71	2.12
	11/14/2002	6.71	7.83	1.12
	2/5/2003	6.48	6.73	0.25
	12/3/2003	6.45	6.91	0.46
	2/11/2004	6.40	6.80	0.40
	3/8/2004	6.51	6.72	0.21
	4/27/2004		6.23	0.00
	5/28/2004		5.92	0.00
	6/29/2004		5.70	0.00
	8/3/2004		6.00	0.00
	9/2/2004		5.17	0.00
	10/13/2004		6.07	0.00
	11/12/2004		6.49	0.00
	1/31/2005		6.13	0.00
	3/24/2005		6.27	0.00
	4/18/2005		6.3	0.00
				0.00

Table 2
Terminal 5 Progress Monitoring
Groundwater Elevations and Product Thickness

Well ID:	Date:	DTP feet (ftbc)	DTW feet (ftbc)	Product Thickness (ft)
				0.00
				0.00
				0.00
				0.00
EW-32	5/8/2002		7.20	0.00
	12/3/2003		6.79	0.00
	3/8/2004		6.82	0.00
	4/27/2004		6.58	0.00
	5/28/2004		6.26	0.00
	6/29/2004		6.29	0.00
	8/3/2004		6.22	0.00
	9/2/2004		6.41	0.00
	10/13/2004		6.55	0.00
	11/12/2004		6.81	0.00
	1/31/2005	6.42	6.45	0.03
	3/24/2005		6.42	0.00
	4/18/2005		6.5	0.00
				0.00
				0.00
				0.00
				0.00
				0.00
EW-33	5/8/2002		7.50	0.00
	12/3/2003	6.60	6.85	0.25
	2/11/2004	6.60	6.90	0.30
	3/8/2004		6.64	0.00
	4/27/2004		6.35	0.00
	5/28/2004		6.05	0.00
	6/29/2004	6.01	6.02	0.01
	8/3/2004		6.09	0.00
	9/2/2004		6.23	0.00
	10/13/2004		6.37	0.00
	11/12/2004	6.56	6.69	0.13
	1/31/2005		6.26	0.00
	3/24/2005		6.27	0.00
	4/18/2005	6.03	6.11	0.08
				0.00
				0.00
				0.00
				0.00
				0.00
EW-34	5/9/2002	6.82	8.90	2.08
	11/14/2002	6.94	7.52	0.58
	2/5/2003	6.63	7.64	1.01
	12/3/2003	6.60	7.09	0.49
	2/11/2004	6.60	6.90	0.30
	3/8/2004	6.65	7.14	0.49

Table 2
Terminal 5 Progress Monitoring
Groundwater Elevations and Product Thickness

Well ID:	Date:	DTP feet (ftbc)	DTW feet (ftbc)	Product Thickness (ft)
	4/27/2004		6.42	0.00
	5/28/2004		6.15	0.00
	6/29/2004		6.03	0.00
	8/3/2004		6.15	0.00
	9/2/2004		6.3	0.00
	10/13/2004	6.44	6.45	0.01
	11/12/2004		6.69	0.00
	1/31/2005	6.34	6.36	0.02
	3/24/2005		6.39	0.00
	4/18/2005		6.33	0.00
				0.00
				0.00
				0.00
				0.00
				0.00
EW-35	5/9/2002	6.79	8.00	1.21
	11/14/2002	6.78	7.17	0.39
	2/5/2003		6.61	0.00
	12/3/2003	6.45	6.70	0.25
	2/11/2004		6.50	0.00
	3/8/2004		6.52	0.00
	4/27/2004		6.23	0.00
	5/28/2004		5.90	0.00
	6/29/2004		5.90	0.00
	8/3/2004		5.99	0.00
	9/2/2004		6.09	0.00
	10/13/2004	6.15	6.16	0.01
	11/12/2004	6.47	6.5	0.03
	1/31/2005		6.19	0.00
	3/24/2005		6.20	0.00
	4/18/2005		6.28	0.00
				0.00
				0.00
				0.00
				0.00
				0.00
EW-36	5/8/2002		7.20	0.00
	12/3/2003		6.60	0.00
	3/8/2004		6.63	0.00
	4/27/2004		6.31	0.00
	5/28/2004		6.03	0.00
	6/29/2004		6.10	0.00
	8/3/2004		6.11	0.00
	9/2/2004		6.2	0.00
	10/13/2004		6.34	0.00
	11/12/2004		6.6	0.00
	1/31/2005		6.25	0.00

Table 2
Terminal 5 Progress Monitoring
Groundwater Elevations and Product Thickness

Well ID:	Date:	DTP feet (ftbc)	DTW feet (ftbc)	Product Thickness (ft)
	3/24/2005		6.27	0.00
	4/18/2005		6.22	0.00
				0.00
				0.00
				0.00
				0.00
				0.00
EW-37	5/8/2002		6.78	0.00
	12/3/2003		6.35	0.00
	3/8/2004		6.50	0.00
	6/29/2004		5.79	0.00
	8/3/2004		5.79	0.00
	9/2/2004		5.95	0.00
	10/13/2004		6.11	0.00
	11/12/2004		6.32	0.00
	1/31/2005		5.99	0.00
	4/18/2005		6.14	0.00
				0.00
				0.00
				0.00
				0.00
				0.00
				0.00
EW-38	5/9/2002	6.87	6.88	0.01
	12/3/2003		6.38	0.00
	3/8/2004		6.60	0.00
	4/27/2004		6.09	0.00
	5/28/2004	5.75	5.76	0.01
	6/29/2004		5.77	0.00
	8/3/2004		5.81	0.00
	9/2/2004		5.98	0.00
	10/13/2004		6.13	0.00
	11/12/2004		6.32	0.00
	1/31/2005		6.06	0.00
	3/24/2005		6.1	0.00
	4/18/2005		5.99	0.00
				0.00
				0.00
				0.00
				0.00
				0.00
EW-39	5/9/2002		5.89	0.00
	12/3/2003		5.41	0.00
	3/8/2004		5.50	0.00
	4/27/2004		5.09	0.00
	5/28/2004		4.75	0.00
	6/29/2004		4.85	0.00

Table 2
Terminal 5 Progress Monitoring
Groundwater Elevations and Product Thickness

Well ID:	Date:	DTP feet (ftbc)	DTW feet (ftbc)	Product Thickness (ft)
	10/13/2004		4.85	0.00
	9/2/2004		5.05	0.00
	10/13/2004	5.19	5.20	0.01
	11/12/2004		5.42	0.00
	1/31/2005		5.08	0.00
	3/24/2005		5.16	0.00
	4/18/2005		5.3	0.00
				0.00
				0.00
				0.00
				0.00
				0.00
EW-40	5/9/2002		6.80	0.00
	12/3/2003		5.64	0.00
	3/8/2004		5.75	0.00
	4/27/2004		5.26	0.00
	5/28/2004		4.99	0.00
	6/29/2004		5.00	0.00
	8/3/2004		5.07	0.00
	9/2/2004		5.29	0.00
	10/13/2004		5.42	0.00
	11/12/2004		5.62	0.00
	1/31/2005		5.3	0.00
	3/24/2005		5.53	0.00
	4/18/2005		5.44	0.00
				0.00
				0.00
				0.00
				0.00
				0.00
EW-41	5/9/2002	5.28	6.67	1.39
	11/12/2002	5.26	6.06	0.80
	2/5/2003	5.15	5.30	0.15
	12/3/2003	4.80	5.70	0.90
	2/13/2004	5.00	6.00	1.00
	3/8/2004	4.96	5.85	0.89
	4/27/2004		4.71	0.00
	5/28/2004		4.36	0.00
	6/29/2004		4.46	0.00
	8/3/2004		4.51	0.00
	9/2/2004		4.72	0.00
	10/13/2004		5.85	0.00
	11/12/2004	4.90	5.85	0.95
	1/31/2005		4.75	0.00
	3/24/2005	4.76	5.03	0.27
	4/18/2005	4.65	4.66	0.01
				0.00

Table 2
Terminal 5 Progress Monitoring
Groundwater Elevations and Product Thickness

Well ID:	Date:	DTP feet (ftbc)	DTW feet (ftbc)	Product Thickness (ft)
				0.00
				0.00
				0.00
				0.00
EW-42	5/9/2002	5.58	7.04	1.46
	11/12/2002	5.69	5.70	0.01
	2/5/2003		5.52	0.00
	12/3/2003		5.38	0.00
	3/8/2004		5.46	0.00
	5/28/2004		4.65	0.00
	6/29/2004		4.80	0.00
	8/3/2004		4.76	0.00
	9/2/2004		5	0.00
	10/13/2004	5.12	5.13	0.01
	11/12/2004		5.35	0.00
	1/31/2005		5.04	0.00
	3/24/2005		5.11	0.00
	4/18/2005		5.07	0.00
				0.00
				0.00
				0.00
				0.00
				0.00
EW-43	5/9/2002		6.10	0.00
	12/3/2003		5.62	0.00
	3/8/2004		5.73	0.00
	4/27/2004		5.27	0.00
	5/28/2004		4.95	0.00
	6/29/2004		5.05	0.00
	8/3/2004		5.11	0.00
	9/2/2004		5.36	0.00
	10/13/2004		5.46	0.00
	11/12/2004		5.68	0.00
	1/31/2005		5.32	0.00
	3/24/2005		5.40	0.00
	4/18/2005		5.33	0.00
				0.00
				0.00
				0.00
				0.00
				0.00
EW-44	5/2/2002		6.40	0.00
	12/3/2003	5.91	6.40	0.49
	2/9/2004	5.98	6.15	0.17
	3/8/2004	6.04	6.05	0.01
	4/27/2004		5.70	0.00
	5/28/2004	5.34	5.36	0.02

Table 2
Terminal 5 Progress Monitoring
Groundwater Elevations and Product Thickness

Well ID:	Date:	DTP feet (ftbc)	DTW feet (ftbc)	Product Thickness (ft)
	6/29/2004	5.43	5.45	0.02
	8/3/2004	5.44	5.47	0.03
	9/2/2004	5.63	5.75	0.12
	10/13/2004	5.73	5.95	0.22
	11/12/2004	5.95	6.24	0.29
	1/31/2005		5.84	0.00
	3/24/2005	5.80	5.81	0.01
	4/18/2005		5.62	0.00
				0.00
				0.00
				0.00
				0.00
				0.00
EW-45	5/10/2002		6.22	0.00
	12/3/2003		5.73	0.00
	3/8/2004		5.79	0.00
	4/27/2004		5.41	0.00
	5/28/2004		5.07	0.00
	6/29/2004		5.17	0.00
	8/3/2004		5.16	0.00
	9/2/2004		5.35	0.00
	10/13/2004		6.51	0.00
	11/12/2004		5.75	0.00
	1/31/2005		5.41	0.00
	3/24/2005		5.52	0.00
	4/18/2005		5.44	0.00
				0.00
				0.00
				0.00
				0.00
				0.00
EW-46	5/10/2002		7.20	0.00
	12/3/2003		5.15	0.00
	3/8/2004		5.20	0.00
	4/27/2004		4.84	0.00
	5/28/2004		4.49	0.00
	6/29/2004		4.58	0.00
	8/3/2004		4.6	0.00
	9/2/2004		4.96	0.00
	10/13/2004		5.93	0.00
	11/12/2004		5.17	0.00
	1/31/2005		4.86	0.00
	3/24/2005		5.00	0.00
	4/18/2005		4.96	0.00
				0.00
				0.00
				0.00

Table 2
Terminal 5 Progress Monitoring
Groundwater Elevations and Product Thickness

Well ID:	Date:	DTP feet (ftbc)	DTW feet (ftbc)	Product Thickness (ft)
				0.00
				0.00
EW-47	5/10/2002	5.45	7.29	1.84
	11/12/2002	5.35	6.33	0.98
	2/5/2003	5.35	5.57	0.22
	12/3/2003	5.01	6.12	1.11
	2/13/2004	5.25	5.70	0.45
	3/8/2004		4.99	0.00
	4/27/2004	4.85	4.86	0.01
	6/29/2004		4.64	0.00
	8/3/2004		4.65	0.00
	9/2/2004		4.85	0.00
	10/13/2004		5.01	0.00
	11/12/2004	5.15	5.52	0.37
	1/31/2005		4.9	0.00
	3/24/2005		5.00	0.00
	4/18/2005		4.78	0.00
				0.00
				0.00
				0.00
				0.00
				0.00
EW-48	5/9/2002	5.76	7.28	1.52
	11/12/2002	5.69	6.86	1.17
	2/5/2003	5.65	6.34	0.69
	12/3/2003	5.40	5.92	0.52
	2/13/2004	5.55	6.40	0.85
	3/8/2004	5.52	6.40	0.88
	4/27/2004		5.21	0.00
	5/28/2004		4.60	0.00
	6/29/2004		5.03	0.00
	8/3/2004		5.00	0.00
	9/2/2004		4.25	0.00
	10/13/2004	5.35	5.37	0.02
	11/12/2004	5.47	6.37	0.90
	1/31/2005		5.25	0.00
	3/24/2005	5.29	5.41	0.12
	4/18/2005		5.09	0.00
				0.00
				0.00
				0.00
				0.00
				0.00
EW-49	5/2/2002		6.64	0.00
	12/3/2003	5.69	6.65	0.96
	2/9/2004	6.30	6.31	0.01
	3/8/2004		6.39	0.00

Table 2
Terminal 5 Progress Monitoring
Groundwater Elevations and Product Thickness

Well ID:	Date:	DTP feet (ftbc)	DTW feet (ftbc)	Product Thickness (ft)
	4/27/2004		5.98	0.00
	5/28/2004		5.70	0.00
	6/29/2004		5.75	0.00
	8/3/2004		5.74	0.00
	9/2/2004		5.95	0.00
	10/13/2004		6.10	0.00
	11/12/2004		6.31	0.00
	1/31/2005		6.06	0.00
	3/24/2005		6.23	0.00
	4/18/2005		6.11	0.00
				0.00
				0.00
				0.00
				0.00
				0.00
EW-50	5/2/2002	5.43	8.45	3.02
	11/13/2002	5.96	7.20	1.24
	2/6/2003	5.94	6.60	0.66
	12/3/2003	5.67	6.55	0.88
	2/9/2004	5.75	6.44	0.69
	3/8/2004	5.85	6.52	0.67
	4/27/2004		5.55	0.00
	5/28/2004		5.02	0.00
	6/29/2004		5.30	0.00
	8/3/2004		5.30	0.00
	9/2/2004		5.45	0.00
	10/13/2004	5.62	5.64	0.02
	11/12/2004	5.71	6.35	0.64
	1/31/2005		5.61	0.00
	3/24/2005		5.73	0.00
	4/18/2005		5.69	0.00
				0.00
				0.00
				0.00
				0.00
				0.00
EW-51	5/10/2002	5.87	8.36	2.49
	11/13/2002	5.91	7.02	1.11
	2/6/2003	5.93	6.33	0.40
	12/3/2003	5.70	6.36	0.66
	2/13/2004	5.80	5.95	0.15
	3/8/2004	5.77	5.91	0.14
	4/27/2004		5.42	0.00
	5/28/2004		5.09	0.00
	6/29/2004		5.20	0.00
	8/3/2004		5.24	0.00
	9/2/2004		5.41	0.00

Table 2
Terminal 5 Progress Monitoring
Groundwater Elevations and Product Thickness

Well ID:	Date:	DTP feet (ftbc)	DTW feet (ftbc)	Product Thickness (ft)
	10/13/2004	5.52	5.53	0.01
	11/12/2004		5.72	0.00
	1/31/2005		5.5	0.00
	3/24/2005		5.63	0.00
	4/18/2005		5.55	0.00
				0.00
				0.00
				0.00
				0.00
				0.00
EW-52	5/10/2002	5.64	7.05	1.41
	11/12/2002	5.58	6.06	0.48
	2/5/2003		5.47	0.00
	12/3/2003	5.32	5.50	0.18
	2/13/2004	5.40	5.55	0.15
	3/8/2004	5.32	5.54	0.22
	4/27/2004		4.98	0.00
	5/28/2004		4.55	0.00
	6/29/2004		4.60	0.00
	8/3/2004		4.72	0.00
	9/2/2004		4.95	0.00
	10/13/2004	5.07	5.08	0.01
	11/12/2004		5.3	0.00
	1/31/2005	4.72	5.31	0.59
	3/24/2005		5.10	0.00
	4/18/2005		5.11	0.00
				0.00
				0.00
				0.00
				0.00
				0.00
EW-53	5/10/2002	5.57	7.40	1.83
	11/12/2002	5.55	6.34	0.79
	2/5/2003	5.49	5.77	0.28
	12/3/2003	5.22	6.11	0.89
	2/13/2004	5.40	5.65	0.25
	3/8/2004	5.38	5.60	0.22
	4/27/2004		4.96	0.00
	5/28/2004		4.62	0.00
	6/29/2004		4.85	0.00
	8/3/2004		4.78	0.00
	9/2/2004	5.00	5.01	0.01
	10/13/2004	5.13	5.17	0.04
	11/12/2004	5.36	5.99	0.63
	1/31/2005		5.06	0.00
	3/24/2005		5.11	0.00
	4/18/2005		5.03	0.00

Table 2
Terminal 5 Progress Monitoring
Groundwater Elevations and Product Thickness

Well ID:	Date:	DTP feet (ftbc)	DTW feet (ftbc)	Product Thickness (ft)
				0.00
				0.00
				0.00
				0.00
				0.00
EW-54	5/2/2002	5.25	7.42	2.17
	11/14/2002	6.30	6.65	0.35
	12/3/2003	5.97	5.98	0.01
	2/9/2004	6.02	6.05	0.03
	3/8/2004		6.03	0.00
	4/27/2004		5.64	0.00
	5/28/2004		5.31	0.00
	6/29/2004		5.41	0.00
	8/3/2004		5.45	0.00
	9/2/2004		5.62	0.00
	10/13/2004		5.70	0.00
	11/12/2004	5.99	6.01	0.02
	1/31/2005		5.79	0.00
	3/24/2005	5.80	6.80	1.00
	4/18/2005	5.55	5.6	0.05
				0.00
				0.00
				0.00
				0.00
				0.00
EW-55	5/2/2002	6.10	9.10	3.00
	11/14/2002	6.31	7.58	1.27
	12/3/2003	6.01	6.72	0.71
	2/9/2004	6.12	6.36	0.24
	3/8/2004	6.21	6.40	0.19
	4/27/2004		5.81	0.00
	5/28/2004		5.45	0.00
	6/29/2004	5.59	5.90	0.31
	8/3/2004	4.52	4.62	0.10
	9/2/2004	5.76	5.8	0.04
	10/13/2004	5.92	5.99	0.07
	11/12/2004	6.11	6.17	0.06
	1/31/2005		6.00	0.00
	3/24/2005		6.00	0.00
	4/18/2005		5.98	0.00
				0.00
				0.00
				0.00
				0.00
				0.00
EW-56	5/6/2002	6.10	6.50	0.40
	11/13/2002	6.28	6.86	0.58

Table 2
Terminal 5 Progress Monitoring
Groundwater Elevations and Product Thickness

Well ID:	Date:	DTP feet (ftbc)	DTW feet (ftbc)	Product Thickness (ft)
	2/6/2003	6.28	6.29	0.01
	12/3/2003	5.95	6.15	0.20
	2/9/2004	6.05	6.22	0.17
	3/8/2004	6.11	6.24	0.13
	4/27/2004		5.73	0.00
	5/28/2004		5.40	0.00
	6/29/2004	5.48	5.51	0.03
	8/3/2004	5.46	5.47	0.01
	9/2/2004	5.24	5.26	0.02
	10/13/2004	5.81	6.00	0.19
	11/12/2004	6.01	6.44	0.43
	1/31/2005		5.85	0.00
	3/24/2005		6.05	0.00
	4/18/2005		5.99	0.00
				0.00
				0.00
				0.00
				0.00
				0.00
EW-57	5/6/2002	5.80	6.10	0.30
	11/13/2002	5.93	6.73	0.80
	2/6/2003		6.90	0.00
	12/3/2003	5.56	6.44	0.88
	2/9/2004	5.69	6.23	0.54
	3/8/2004	5.72	6.03	0.31
	4/27/2004	5.38	5.40	0.02
	5/28/2004		5.05	0.00
	6/29/2004		5.15	0.00
	8/3/2004		5.21	0.00
	9/2/2004		5.39	0.00
	10/13/2004		5.51	0.00
	11/12/2004	5.71	5.75	0.04
	1/31/2005		5.48	0.00
	3/24/2005	5.60	5.61	0.01
	4/18/2005		5.23	0.00
				0.00
				0.00
				0.00
				0.00
				0.00
EW-58	5/6/2002	6.10	6.20	0.10
	11/13/2002		5.94	0.00
	2/6/2003		5.88	0.00
	12/3/2003	5.53	5.85	0.32
	2/13/2004	5.70	5.71	0.01
	3/8/2004		5.71	0.00
	4/27/2004		5.22	0.00

Table 2
Terminal 5 Progress Monitoring
Groundwater Elevations and Product Thickness

Well ID:	Date:	DTP feet (ftbc)	DTW feet (ftbc)	Product Thickness (ft)
	5/28/2004		4.92	0.00
	6/29/2004		5.08	0.00
	8/3/2004		5.01	0.00
	9/2/2004		5.27	0.00
	10/13/2004		5.38	0.00
	11/12/2004		5.55	0.00
	1/31/2005		5.32	0.00
	3/24/2005		6.52	0.00
	4/18/2005		6.44	0.00
				0.00
				0.00
				0.00
				0.00
				0.00
EW-59	5/15/2002	6.06	8.31	2.25
	11/14/2002	6.12	6.48	0.36
	2/3/2003		6.01	0.00
	12/3/2003	5.71	6.42	0.71
	2/24/2004	5.78	6.52	0.74
	3/8/2004	5.68	6.05	0.37
	4/27/2004		5.49	0.00
	5/28/2004		5.24	0.00
	6/29/2004		5.35	0.00
	8/3/2004		5.28	0.00
	9/2/2004		5.44	0.00
	10/13/2004	5.61	5.66	0.05
	11/12/2004	5.72	6.43	0.71
	1/31/2005		5.7	0.00
	3/24/2005	5.40	5.60	0.20
	4/18/2005	5.39	5.4	0.01
				0.00
				0.00
				0.00
				0.00
				0.00
EW-60	5/15/2002	6.12	8.58	2.46
	11/14/2002	6.11	7.12	1.01
	2/3/2003		6.08	0.00
	12/3/2003	5.84	6.40	0.56
	2/24/2004	5.89	6.66	0.77
	3/8/2004	5.86	6.42	0.56
	4/27/2004		5.57	0.00
	5/28/2004		5.31	0.00
	6/29/2004		5.21	0.00
	8/3/2004		5.35	0.00
	9/2/2004		5.5	0.00
	10/13/2004	5.67	5.68	0.01

Table 2
Terminal 5 Progress Monitoring
Groundwater Elevations and Product Thickness

Well ID:	Date:	DTP feet (ftbc)	DTW feet (ftbc)	Product Thickness (ft)
	11/12/2004		5.92	0.00
	1/31/2005		5.61	0.00
	3/24/2005		6.09	0.00
	4/18/2005		5.99	0.00
				0.00
				0.00
				0.00
				0.00
				0.00
EW-61	5/15/2002	6.17	8.86	2.69
	11/14/2002	6.20	7.31	1.11
	2/3/2003	6.14	6.21	0.07
	12/3/2003	5.86	6.55	0.69
	2/10/2004	5.93	7.80	1.87
	3/8/2004	5.94	6.43	0.49
	4/27/2004		5.67	0.00
	5/28/2004		5.37	0.00
	6/29/2004		5.37	0.00
	8/3/2004		5.44	0.00
	9/2/2004		5.64	0.00
	10/13/2004		5.79	0.00
	11/12/2004		6.03	0.00
	1/31/2005	5.82	6.12	0.30
	3/24/2005		6.11	0.00
	4/18/2005		6.13	0.00
				0.00
				0.00
				0.00
				0.00
				0.00
EW-62	5/13/2002	6.00	8.31	2.31
	11/13/2002	6.02	7.16	1.14
	2/6/2003	6.10	6.44	0.34
	12/3/2003	5.73	6.80	1.07
	2/10/2004	5.83	6.60	0.77
	3/8/2004	5.81	6.42	0.61
	4/27/2004		5.50	0.00
	5/28/2004	5.19	5.21	0.02
	6/29/2004	5.25	5.34	0.09
	8/3/2004	5.31	5.35	0.04
	9/2/2004	5.55	5.56	0.01
	10/13/2004	5.68	5.75	0.07
	11/12/2004	5.88	5.96	0.08
	1/31/2005		5.66	0.00
	3/24/2005		5.80	0.00
	4/18/2005		5.83	0.00
				0.00

Table 2
Terminal 5 Progress Monitoring
Groundwater Elevations and Product Thickness

Well ID:	Date:	DTP feet (ftbc)	DTW feet (ftbc)	Product Thickness (ft)
				0.00
				0.00
				0.00
				0.00
EW-63	5/9/2002		6.25	0.00
	11/13/2002	6.00	6.32	0.32
	2/6/2003		6.03	0.00
	12/3/2003	5.62	6.49	0.87
	2/10/2004	5.78	6.05	0.27
	3/8/2004	5.70	6.13	0.43
	4/27/2004		5.40	0.00
	5/28/2004		5.18	0.00
	6/29/2004	5.20	5.22	0.02
	8/3/2004		5.30	0.00
	9/2/2004	5.39	5.4	0.01
	10/13/2004	5.51	5.72	0.21
	11/12/2004	5.60	6.56	0.96
	1/31/2005		5.51	0.00
	3/24/2005	5.62	5.63	0.01
	4/18/2005		5.23	0.00
				0.00
				0.00
				0.00
				0.00
				0.00
EW-64	5/15/2002	5.77	8.35	2.58
	11/14/2002	5.68	7.07	1.39
	2/3/2003	5.68	6.42	0.74
	12/3/2003	5.48	6.06	0.58
	2/24/2004	5.53	6.19	0.66
	3/8/2004	5.51	6.02	0.51
	4/27/2004		6.21	0.00
	5/28/2004		4.95	0.00
	6/29/2004	5.03	5.10	0.07
	8/3/2004		4.82	0.00
	9/2/2004	5.21	5.32	0.11
	10/13/2004	5.32	5.60	0.28
	11/12/2004	5.48	5.8	0.32
	1/31/2005		5.55	0.00
	3/24/2005	5.40	5.70	0.30
	4/18/2005	5.44	5.52	0.08
				0.00
				0.00
				0.00
				0.00
				0.00
EW-65	5/15/2002	5.64	7.17	1.53

Table 2
Terminal 5 Progress Monitoring
Groundwater Elevations and Product Thickness

Well ID:	Date:	DTP feet (ftbc)	DTW feet (ftbc)	Product Thickness (ft)
	11/14/2002	5.86	6.04	0.18
	2/3/2003		5.76	0.00
	12/3/2003	5.40	6.06	0.66
	2/10/2004	5.44	6.62	1.18
	3/8/2004	5.51	5.78	0.27
	4/27/2004		5.16	0.00
	5/28/2004		4.90	0.00
	6/29/2004		4.89	0.00
	8/3/2004		5.05	0.00
	9/2/2004		5.2	0.00
	10/13/2004		5.4	0.00
	11/12/2004	5.39	6.21	0.82
	1/31/2005		5.38	0.00
	3/24/2005		5.80	0.00
	4/18/2005		5.77	0.00
				0.00
				0.00
				0.00
				0.00
				0.00
EW-66	5/6/2002		5.80	0.00
	12/3/2003		5.28	0.00
	2/10/2004		5.37	0.00
	3/8/2004		5.28	0.00
	4/27/2004		4.89	0.00
	5/28/2004		4.60	0.00
	6/29/2004		4.70	0.00
	8/3/2004		4.76	0.00
	9/2/2004		4.96	0.00
	10/13/2004		5.1	0.00
	11/12/2004		5.28	0.00
	1/31/2005		5.24	0.00
	3/24/2005		5.30	0.00
	4/18/2005		5.24	0.00
				0.00
				0.00
				0.00
				0.00
				0.00
EW-67	5/15/2002	5.81	8.55	2.74
	11/15/2002	5.78	7.38	1.60
	2/4/2003	5.73	6.91	1.18
	12/3/2003	5.54	6.45	0.91
	2/19/2004	5.57	6.46	0.89
	3/8/2004	5.55	6.45	0.90
	4/27/2004	5.30	5.34	0.04
	5/28/2004		5.07	0.00

Table 2
Terminal 5 Progress Monitoring
Groundwater Elevations and Product Thickness

Well ID:	Date:	DTP feet (ftbc)	DTW feet (ftbc)	Product Thickness (ft)
	6/29/2004		5.15	0.00
	8/3/2004		5.12	0.00
	9/2/2004		5.31	0.00
	10/13/2004	5.44	5.52	0.08
	11/12/2004	5.60	5.69	0.09
	1/31/2005		5.47	0.00
	3/24/2005		5.61	0.00
	4/18/2005		5.65	0.00
				0.00
				0.00
				0.00
				0.00
				0.00
EW-68	5/8/2002		5.95	0.00
	12/3/2003		5.41	0.00
	3/8/2004		5.42	0.00
	4/27/2004		4.95	0.00
	5/28/2004		4.75	0.00
	6/29/2004		4.86	0.00
	8/3/2004		4.82	0.00
	9/2/2004		6.04	0.00
	10/13/2004		5.19	0.00
	11/12/2004		5.4	0.00
	1/31/2005		5.25	0.00
	3/24/2005		5.42	0.00
	4/18/2005		5.36	0.00
				0.00
				0.00
				0.00
				0.00
				0.00
EW-69	5/16/2002	5.90	8.48	2.58
	11/15/2002	5.82	7.22	1.40
	2/4/2003	5.79	6.98	1.19
	12/3/2003	5.56	6.50	0.94
	2/11/2004	5.63	6.78	1.15
	3/8/2004	5.61	6.32	0.71
	4/27/2004		5.28	0.00
	5/28/2004		5.08	0.00
	6/29/2004	5.16	5.25	0.09
	8/3/2004	5.12	5.30	0.18
	9/2/2004	5.31	5.51	0.20
	10/13/2004	5.43	5.81	0.38
	11/12/2004	5.56	6.54	0.98
	1/31/2005	5.58	5.92	0.34
	3/24/2005	5.62	5.96	0.34
	4/18/2005	5.59	5.97	0.38

Table 2
Terminal 5 Progress Monitoring
Groundwater Elevations and Product Thickness

Well ID:	Date:	DTP feet (ftbc)	DTW feet (ftbc)	Product Thickness (ft)
				0.00
				0.00
				0.00
				0.00
				0.00
EW-70	5/16/2002	6.65	9.35	2.70
	11/15/2002	6.58	8.27	1.69
	2/4/2003	6.58	8.12	1.54
	12/3/2003	6.30	7.75	1.45
	2/11/2004	6.34	7.80	1.46
	3/8/2004	6.35	7.57	1.22
	4/27/2004		6.11	0.00
	5/28/2004		5.92	0.00
	6/29/2004		6.00	0.00
	8/3/2004		5.97	0.00
	9/2/2004		5.15	0.00
	10/13/2004	6.21	6.83	0.62
	11/12/2004	6.31	7.16	0.85
	1/31/2005		6.45	0.00
	3/24/2005	6.30	6.92	0.62
	4/18/2005	6.15	6.33	0.18
				0.00
				0.00
				0.00
				0.00
				0.00
EW-71	5/8/2002	6.75	8.10	1.35
	11/15/2002	6.72	7.07	0.35
	2/4/2003	6.89	7.16	0.27
	12/3/2003	6.42	6.75	0.33
	2/11/2004	6.48	6.75	0.27
	3/8/2004		6.45	0.00
	4/27/2004		5.99	0.00
	5/28/2004		5.82	0.00
	6/29/2004		5.92	0.00
	8/3/2004		5.97	0.00
	9/2/2004	5.07	5.14	0.07
	10/13/2004	6.22	6.31	0.09
	11/12/2004	6.42	6.51	0.09
	1/31/2005	6.46	6.51	0.05
	3/24/2005		6.33	0.00
	4/18/2005		5.99	0.00
				0.00
				0.00
				0.00
				0.00
				0.00

Table 2
Terminal 5 Progress Monitoring
Groundwater Elevations and Product Thickness

Well ID:	Date:	DTP feet (ftbc)	DTW feet (ftbc)	Product Thickness (ft)
EW-72	5/16/2002	7.43	9.71	2.28
	11/15/2002	7.54	8.09	0.55
	2/4/2003	7.56	8.06	0.50
	12/3/2002	7.11	8.23	1.12
	2/11/2004	7.14	8.07	0.93
	3/8/2004	7.24	7.68	0.44
	4/27/2004		6.84	0.00
	5/28/2004		6.68	0.00
	6/29/2004		6.77	0.00
	8/3/2004		6.75	0.00
	9/2/2004		6.86	0.00
	10/13/2004		7.03	0.00
	11/12/2004		7.26	0.00
	1/31/2005	7.16	7.77	0.61
	3/24/2005	7.05	7.95	0.90
	4/18/2005	6.85	6.99	0.14
				0.00
				0.00
				0.00
				0.00
				0.00
EW-73	5/8/2002		7.71	0.00
	11/15/2002	7.49	7.71	0.22
	2/4/2003	7.55	7.65	0.10
	12/3/2003	7.24	7.25	0.01
	2/11/2004		7.25	0.00
	5/28/2004		6.61	0.00
	6/29/2004		6.68	0.00
	8/3/2004		6.55	0.00
	9/2/2004		6.84	0.00
	10/13/2004		7.00	0.00
	11/12/2004		7.19	0.00
	1/31/2005	7.24	7.25	0.01
	3/24/2005		7.05	0.00
	4/18/2005		6.98	0.00
				0.00
				0.00
				0.00
				0.00
				0.00
EW-74	4/27/2004		6.49	0.00
	5/28/2004		6.39	0.00
	6/29/2004		6.48	0.00
	8/3/2004		6.44	0.00
	9/2/2004	6.61	6.68	0.07
	10/13/2004	6.74	7.05	0.31
	11/12/2004	6.91	7.35	0.44

Table 2
Terminal 5 Progress Monitoring
Groundwater Elevations and Product Thickness

Well ID:	Date:	DTP feet (ftbc)	DTW feet (ftbc)	Product Thickness (ft)
	1/31/2005	6.86	7.31	0.45
	3/24/2005	6.85	6.93	0.08
	4/18/2005		6.62	0.00
				0.00
				0.00
				0.00
				0.00
				0.00
EW-75	4/27/2004		5.50	0.00
	5/28/2004		5.30	0.00
	6/29/2004	5.36	5.50	0.14
	8/3/2004	5.35	5.50	0.15
	9/2/2004	5.49	5.78	0.29
	10/13/2004	5.60	6.42	0.82
	11/12/2004	5.77	6.56	0.79
	1/31/2005	5.73	6.38	0.65
	3/24/2005	5.76	6.25	0.49
	4/18/2005	5.66	5.89	0.23
				0.00
				0.00
				0.00
				0.00
				0.00
EW-76	4/27/2004		5.45	0.00
	5/28/2004		5.19	0.00
	6/29/2004		5.28	0.00
	8/3/2004		5.27	0.00
	9/2/2004	5.44	5.45	0.01
	10/13/2004	5.55	5.89	0.34
	11/12/2004	5.69	6.6	0.91
	1/31/2005		5.85	0.00
	3/24/2005		5.70	0.00
	4/18/2005		5.68	0.00
				0.00
				0.00
				0.00
				0.00
				0.00
EW-77	4/27/2004		5.51	0.00
	5/28/2004		5.17	0.00
	6/29/2004		5.28	0.00
	8/3/2004		5.28	0.00
	9/2/2004		5.47	0.00
	10/13/2004	5.60	5.75	0.15
	11/12/2004	5.72	6.08	0.36
	1/31/2005		5.59	0.00
	3/24/2005	5.75	5.86	0.11

Table 2
Terminal 5 Progress Monitoring
Groundwater Elevations and Product Thickness

Well ID:	Date:	DTP feet (ftbc)	DTW feet (ftbc)	Product Thickness (ft)
	4/18/2005	5.66	5.71	0.05
				0.00
				0.00
				0.00
				0.00
				0.00
EW-78	4/27/2004		4.71	0.00
	5/28/2004		4.78	0.00
	6/29/2004		4.51	0.00
	8/3/2004		4.50	0.00
	9/2/2004		4.75	0.00
	10/13/2004	4.84	4.85	0.01
	11/12/2004		5.09	0.00
	1/31/2005		4.74	0.00
	3/24/2005		4.82	0.00
	4/18/2005		4.5	0.00
				0.00
				0.00
				0.00
				0.00
				0.00
EW-79	4/27/2004		6.34	0.00
	5/28/2004		6.04	0.00
	6/29/2004		6.15	0.00
	8/3/2004	6.05	6.06	0.01
	9/2/2004	6.16	6.22	0.06
	10/13/2004	6.34	6.40	0.06
	11/12/2004	6.60	6.68	0.08
	1/31/2005	6.23	6.24	0.01
	3/24/2005	6.30	6.31	0.01
	4/18/2005		6.14	0.00
				0.00
				0.00
				0.00
				0.00
				0.00
EW-80	4/27/2004		5.79	0.00
	5/28/2004		5.38	0.00
	6/29/2004		5.41	0.00
	8/3/2004		5.40	0.00
	9/2/2004		5.55	0.00
	10/13/2004		5.69	0.00
	11/12/2004	5.93	6.11	0.18
	3/24/2005		5.75	0.00
	4/18/2005		5.68	0.00
				0.00
				0.00

J.F.K. International Airport - TWA Terminal 6
UAL Phase II Subsurface Investigation Data
Groundwater Elevation and SPH Gauging Data

February 19, 2001

WELL ID	DATE	CASING ELEVATION (ft)	DTW (ft)	DTB (ft)	DTP (ft)	PRODUCT THICKNESS (ft)	GROUNDWATER ELEVATION (ft)	PRODUCT ELEVATION (ft)	CORRECTED GROUNDWATER ELEVATION (ft)	PRODUCT RECOVERED (ml)
UAL-MW1	2/19/2001	15.12	7.18	13.55	-	0	7.94	-	-	0
UAL-MW2	2/19/2001	13.89	6.08	12.60	-	0	7.81	-	-	0
UAL-MW3	2/19/2001	13.81	7.18	NM	5.12	2.06	6.63	8.69	8.07	0
UAL-MW4	2/19/2001	15.55	7.10	NM	6.84	0.26	8.45	8.71	8.63	0
UAL-MW5	2/19/2001	15.05	6.62	13.70	-	0	8.43	-	-	0
UAL-MW6	2/19/2001	15.98	7.45	14.65	6.79	0.66	8.53	9.19	8.99	0
UAL-MW7	2/19/2001	16.07	6.87	13.60	-	0	9.20	-	-	0
UAL-MW8	2/19/2001	15.17	6.31	14.70	-	0	8.86	-	-	0
UAL-MW9	2/19/2001	13.74	4.80	12.70	-	0	8.94	-	-	0
UAL-MW10	NOT YET INSTALLED									
UAL-MW11	NOT YET INSTALLED									
UAL-MW12	NOT YET INSTALLED									
UAL-MW13	2/19/2001	13.02	6.11	11.20	-	0	6.91	-	-	0
UAL-MW14	2/19/2001	12.63	6.00	8.66	-	0	6.63	-	-	0
UAL-MW15	2/19/2001	13.68	5.22	13.60	-	0	8.47	-	-	0
UAL-MW16	2/19/2001	11.83	3.56	9.54	-	0	8.27	-	-	0
UAL-MW17	2/19/2001	12.13	3.85	12.20	-	0	8.28	-	-	0
UAL-MW18	2/19/2001	12.40	4.28	13.75	-	0	8.12	-	-	0
UAL-MW19	NOT YET INSTALLED									
UAL-MW20	NOT YET INSTALLED									
UAL-MW21	NOT YET INSTALLED									
UAL-MW22	NOT YET INSTALLED									
UAL-MW23	NOT YET INSTALLED									
UAL-MW24	NOT YET INSTALLED									
UAL-MW25	NOT YET INSTALLED									
UAL-MW26	NOT YET INSTALLED									
UAL-MW27	NOT YET INSTALLED									
UAL-MW28	NOT YET INSTALLED									
UAL-MW29	NOT YET INSTALLED									
UAL-MW30	NOT YET INSTALLED									
UAL-MW31	NOT YET INSTALLED									
UAL-MW32	NOT YET INSTALLED									
UAL-MW33	NOT YET INSTALLED									
UAL-MW34	NOT YET INSTALLED									
PA-MW1	4/4/2001	NM	7.11	-	6.00	1.11	-	-	-	0
PA-MW2	4/4/2001	NM	6.98	-	-	-	-	-	-	0
PA-MW3	4/4/2001	NM	-	-	-	-	-	-	-	0
PA-MW4	4/4/2001	NM	-	-	-	-	-	-	-	0
PA-MW5	4/4/2001	NM	-	-	-	-	-	-	-	0

DTW = depth to water
DTB = depth to bottom
DTP = depth to product

J.F.K. International Airport - TWA Terminal 5
UAL Phase II Subsurface Investigation Data
Groundwater Elevation and SPH Gauging Data

February 27, 2001

WELL ID	DATE	CASING ELEVATION (ft)	DTW (ft)	DTB (ft)	DTP (ft)	PRODUCT THICKNESS (ft)	GROUNDWATER ELEVATION (ft)	PRODUCT ELEVATION (ft)	CORRECTED GROUNDWATER ELEVATION (ft)	PRODUCT RECOVERED (ml)
UAL-MW1	2/27/2001	15.12	7.00	13.55	-	0	8.12	-	-	0
UAL-MW2	2/27/2001	13.89	6.06	12.60	-	0	7.83	-	-	0
UAL-MW3	2/27/2001	13.81	7.18	NM	5.12	2.06	6.63	8.69	8.07	0
UAL-MW4	2/27/2001	15.55	7.01	NM	6.81	0.20	8.54	8.74	8.68	0
UAL-MW5	2/27/2001	15.05	6.61	13.70	-	0	8.44	-	-	0
UAL-MW6	2/27/2001	15.98	7.45	14.65	6.79	0.66	8.53	8.19	8.99	0
UAL-MW7	2/27/2001	16.07	7.81	13.60	-	0	8.26	-	-	0
UAL-MW8	2/27/2001	15.17	6.22	14.70	-	0	8.95	-	-	0
UAL-MW9	2/27/2001	13.74	5.01	12.70	-	0	8.73	-	-	0
UAL-MW10	2/27/2001	13.37	5.71	12.70	-	0	7.66	-	-	0
UAL-MW11	2/27/2001	13.25	5.93	12.95	-	0	7.32	-	-	0
UAL-MW12	2/27/2001	NM	NM	NM	-	0	NM	-	-	0
UAL-MW13	2/27/2001	13.02	6.04	11.20	-	0	6.98	-	-	0
UAL-MW14	2/27/2001	12.83	6.03	8.65	-	0	6.80	-	-	0
UAL-MW15	2/27/2001	13.69	5.22	13.60	-	0	8.47	-	-	0
UAL-MW16	2/27/2001	11.83	3.37	9.64	-	0	8.46	-	-	0
UAL-MW17	2/27/2001	12.13	3.17	12.20	-	0	8.96	-	-	0
UAL-MW18	2/27/2001	12.40	4.09	13.75	-	0	8.31	-	-	0
UAL-MW19	2/27/2001	14.03	5.01	14.40	-	0	9.02	-	-	0
UAL-MW20	2/27/2001	NOT YET INSTALLED								
UAL-MW21	2/27/2001	NOT YET INSTALLED								
UAL-MW22	2/27/2001	15.57	6.86	14.66	-	0	8.71	-	-	0
UAL-MW23	2/27/2001	NOT YET INSTALLED								
UAL-MW24	2/27/2001	NOT YET INSTALLED								
UAL-MW25	2/27/2001	NOT YET INSTALLED								
UAL-MW26	2/27/2001	NOT YET INSTALLED								
UAL-MW27	2/27/2001	NOT YET INSTALLED								
UAL-MW28	2/27/2001	NOT YET INSTALLED								
UAL-MW29	2/27/2001	NOT YET INSTALLED								
UAL-MW30	2/27/2001	15.79	6.76	14.66	-	0	9.03	-	-	0
UAL-MW31	2/27/2001	NOT YET INSTALLED								
UAL-MW32	2/27/2001	NOT YET INSTALLED								
UAL-MW33	2/27/2001	NOT YET INSTALLED								
UAL-MW34	2/27/2001	NOT YET INSTALLED								
PA-MW1	2/27/2001	NM	-	-	-	-	-	-	-	0
PA-MW2	2/27/2001	NM	-	-	-	-	-	-	-	0
PA-MW3	2/27/2001	NM	-	-	-	-	-	-	-	0
PA-MW4	2/27/2001	NM	-	-	-	-	-	-	-	0
PA-MW5	2/27/2001	NM	-	-	-	-	-	-	-	0

DTW = depth to water
DTB = depth to bottom
DTP = depth to product

J.F.K. International Airport - TWA Terminal 5
UAL Phase II Subsurface Investigation Data
Groundwater Elevation and SPH Gauging Data

March 19, 2001

WELL ID	DATE	CASING ELEVATION (ft)	DTW (ft)	DTB (ft)	DTP (ft)	PRODUCT THICKNESS (ft)	GROUNDWATER ELEVATION (ft)	PRODUCT ELEVATION (ft)	CORRECTED GROUNDWATER ELEVATION (ft)	PRODUCT RECOVERED (ml)
UAL-MW1	3/19/2001	15.12	6.90	13.55	-	0	8.22	-	-	0
UAL-MW2	3/19/2001	13.89	6.00	12.60	-	0	7.89	-	-	0
UAL-MW3	3/19/2001	13.81	6.65	NM	5.05	1.60	7.16	8.76	8.28	0
UAL-MW4	3/19/2001	15.55	7.11	NM	6.67	0.44	8.44	8.88	8.75	0
UAL-MW5	3/19/2001	15.05	6.52	13.70	-	0	8.53	-	-	0
UAL-MW6	3/19/2001	15.98	7.45	14.65	6.66	0.79	8.53	9.32	9.08	0
UAL-MW7	3/19/2001	16.07	6.80	13.60	-	0	9.27	-	-	0
UAL-MW8	3/19/2001	16.17	6.10	14.70	-	0	9.07	-	-	0
UAL-MW9	3/19/2001	13.74	4.56	12.70	-	0	9.18	-	-	0
UAL-MW10	3/19/2001	13.37	5.60	12.70	-	0	7.77	-	-	0
UAL-MW11	3/19/2001	13.25	5.80	12.95	-	0	7.45	-	-	0
UAL-MW12	3/19/2001	12.93	5.12	13.80	-	0	7.81	-	-	0
UAL-MW13	3/19/2001	13.02	5.91	11.20	-	0	7.11	-	-	0
UAL-MW14	3/19/2001	12.83	5.80	8.65	-	0	7.03	-	-	0
UAL-MW15	3/19/2001	13.69	4.95	13.60	-	0	8.74	-	-	0
UAL-MW16	3/19/2001	11.83	3.27	9.54	-	0	8.56	-	-	0
UAL-MW17	3/19/2001	12.13	3.68	12.20	-	0	8.45	-	-	0
UAL-MW18	3/19/2001	12.40	4.04	13.75	-	0	8.36	-	-	0
UAL-MW19	3/19/2001	14.03	4.95	14.40	-	0	9.08	-	-	0
UAL-MW20	3/19/2001	15.42	6.35	12.60	-	0	9.07	-	-	0
UAL-MW21	3/19/2001	14.83	5.55	12.80	-	0	9.28	-	-	0
UAL-MW22	3/19/2001	15.67	6.75	14.65	-	0	8.82	-	-	0
UAL-MW23	3/19/2001	14.47	6.01	12.65	5.35	0.66	8.46	9.12	8.92	0
UAL-MW24	3/19/2001	14.53	7.40	13.65	6.12	1.28	7.13	8.41	8.03	0
UAL-MW25	3/19/2001	13.27	5.14	11.92	-	0	8.13	-	-	0
UAL-MW26	3/19/2001	13.04	4.71	12.62	-	0	8.33	-	-	0
UAL-MW27	3/19/2001	15.12	6.30	12.60	-	0	8.82	-	-	0
UAL-MW28	3/19/2001	15.18	6.67	14.67	-	0	8.51	-	-	0
UAL-MW29	3/19/2001	14.48	6.75	13.65	-	0	7.73	-	-	0
UAL-MW30	3/19/2001	15.79	6.57	14.65	-	0	9.22	-	-	0
UAL-MW31	3/19/2001	12.12	5.05	12.70	-	0	7.07	-	-	0
UAL-MW32	3/19/2001	12.61	5.65	12.80	-	0	7.16	-	-	0
UAL-MW33	3/19/2001	12.26	4.48	10.96	-	0	7.78	-	-	0
UAL-MW34	3/19/2001	12.33	5.40	NM	4.92	0.48	6.93	7.41	7.27	0
PA-MW1	3/19/2001	NM	-	-	-	-	-	-	-	0
PA-MW2	3/19/2001	NM	-	-	-	-	-	-	-	0
PA-MW3	3/19/2001	NM	-	-	-	-	-	-	-	0
PA-MW4	3/19/2001	NM	-	-	-	-	-	-	-	0
PA-MW5	3/19/2001	NM	-	-	-	-	-	-	-	0

DTW = depth to water
DTB = depth to bottom
DTP = depth to product

WELL ID	GROUNDWATER ELEVATION (ft)	CORRECTED GROUNDWATER ELEVATION (ft)	4/16 - Change	5/4 - Change	5/18 - Change	6/1 - Change
UAL-MW1	8.42	-	-0.08	-0.10	-0.15	-0.14
UAL-MW2	8.00	-	-0.11	-0.21	-0.26	-0.07
UAL-MW3	7.79	8.53	-0.18	-0.26	-0.22	-0.20
UAL-MW4	8.62	8.95	-0.14	-0.17	-0.29	-0.02
UAL-MW5	9.00	-	-0.07	0.21	0.39	0.38
UAL-MW6	9.75	9.79	-0.02	0.36		0.69
UAL-MW7	10.10	-				
UAL-MW8	9.35	-	-0.12	-0.01	0.12	0.13
UAL-MW9	9.48	-	-0.10	0.22	0.38	0.29
UAL-MW10	8.02	-	-0.06	-0.03	-0.03	-0.11
UAL-MW11	7.65	-	-0.15	-0.12	-0.10	-0.12
UAL-MW12	7.96	-	-0.13	-0.11	-0.08	-0.16
UAL-MW13	7.26	7.30	-1.26	0.02	-0.06	-0.10
UAL-MW14	7.28	-	-0.12	0.04	0.25	0.24
UAL-MW15	9.08	-	-0.03	0.48	0.66	0.43
UAL-MW16	8.83	-	-0.04	0.45	0.63	0.39
UAL-MW17	8.61	-	-0.08	0.24	0.38	0.22
UAL-MW18	9.09	-	0.07	0.85	1.06	0.96
UAL-MW19	9.39	-	-0.19	-0.12	0.01	0.12
UAL-MW20	9.34	-	-0.11	-0.15	-0.03	0.08
UAL-MW21	8.99	-	-0.87	-0.57		
UAL-MW22	9.04	-	-0.14	-0.11	-0.04	0.02
UAL-MW23	9.08	9.22	-0.22	-0.25	-0.09	0.03
UAL-MW24	7.36	8.18	-0.17	-0.26	-0.28	-0.25
UAL-MW25	8.46	-	-0.10	0.26	0.34	0.09
UAL-MW26	8.50	-	-0.11	-0.13	-0.13	-0.14
UAL-MW27	9.00	-	-0.17	-0.22	-0.17	-0.10
UAL-MW28	8.71	-	-0.08	-0.15	-0.14	-0.10
UAL-MW29	8.88	-	-0.11	-0.24	-0.12	-1.02
UAL-MW30	9.68	-	-0.10	0.29	0.47	-0.46
UAL-MW31	7.48	-	-0.13	0.17	0.37	0.27
UAL-MW32	7.62	-	0.37	0.22	0.45	0.31
UAL-MW33	8.10	-	-0.13	0.25	0.46	0.40
UAL-MW34	7.13	7.46	-0.09	0.29	0.46	0.39
PA-MW1	-	-				
PA-MW2	-	-				
PA-MW3	-	-				
PA-MW4	-	-				
PA-MW5	-	-				

Table 1
J.F.K. International Airport - TWA Terminal 6
UAL Phase II Subsurface Investigation Data
Groundwater Elevation and SPH Gauging Data

April 4, 2001

WELL ID	DATE	CASING ELEVATION (ft)	DTW (ft)	DTB (ft)	DTP (ft)	PRODUCT THICKNESS (ft)	GROUNDWATER ELEVATION (ft)	PRODUCT ELEVATION (ft)	CORRECTED GROUNDWATER ELEVATION (ft)	PRODUCT RECOVERED (ml)
UAL-MW1	4/4/2001	15.12	6.70	13.55	-	0	8.42	-	-	0
UAL-MW2	4/4/2001	13.89	5.89	12.60	-	0	8.00	-	-	0
UAL-MW3	4/4/2001	13.61	6.02	NM	4.97	1.05	7.79	8.84	8.53	0
UAL-MW4	4/4/2001	15.55	6.93	NM	6.46	0.47	8.62	9.09	8.95	0
UAL-MW5	4/4/2001	15.05	6.05	13.70	-	0	9.00	-	-	0
UAL-MW6	4/4/2001	15.98	6.23	14.65	6.17	0.06	9.75	9.81	9.79	0
UAL-MW7	4/4/2001	16.07	5.97	13.80	-	0	10.10	-	-	0
UAL-MW8	4/4/2001	15.17	5.82	14.70	-	0	9.35	-	-	0
UAL-MW9	4/4/2001	13.74	4.26	12.70	-	0	9.48	-	-	0
UAL-MW10	4/4/2001	13.37	5.35	12.70	-	0	8.02	-	-	0
UAL-MW11	4/4/2001	13.25	5.60	12.95	-	0	7.65	-	-	0
UAL-MW12	4/4/2001	12.93	4.97	13.80	-	0	7.96	-	-	0
UAL-MW13	4/4/2001	13.02	5.76	11.20	5.7	0.06	7.26	7.32	7.30	0
UAL-MW14	4/4/2001	12.83	5.55	8.65	-	0	7.28	-	-	0
UAL-MW15	4/4/2001	13.69	4.61	13.60	-	0	9.08	-	-	0
UAL-MW16	4/4/2001	11.83	3.00	9.54	-	0	8.83	-	-	0
UAL-MW17	4/4/2001	12.13	3.52	12.20	-	0	8.61	-	-	0
UAL-MW18	4/4/2001	12.40	3.31	13.75	-	0	9.09	-	-	0
UAL-MW19	4/4/2001	14.03	4.64	14.40	-	0	9.39	-	-	0
UAL-MW20	4/4/2001	15.42	6.08	12.60	-	0	9.34	-	-	0
UAL-MW21	4/4/2001	14.83	5.84	12.80	-	0	8.99	-	-	0
UAL-MW22	4/4/2001	15.57	6.53	14.85	-	0	9.04	-	-	0
UAL-MW23	4/4/2001	14.47	5.39	12.65	5.19	0.20	9.08	9.28	9.22	0
UAL-MW24	4/4/2001	14.53	7.17	13.65	6.00	1.17	7.36	8.53	8.18	0
UAL-MW25	4/4/2001	13.27	4.81	11.92	-	0	8.46	-	-	0
UAL-MW26	4/4/2001	13.04	4.54	12.82	-	0	8.50	-	-	0
UAL-MW27	4/4/2001	15.12	6.12	12.60	-	0	9.00	-	-	0
UAL-MW28	4/4/2001	15.18	6.47	14.67	-	0	8.71	-	-	0
UAL-MW29	4/4/2001	14.48	5.60	13.65	-	0	8.88	-	-	0
UAL-MW30	4/4/2001	15.79	6.11	14.85	-	0	9.68	-	-	0
UAL-MW31	4/4/2001	12.12	4.64	12.70	-	0	7.48	-	-	0
UAL-MW32	4/4/2001	12.81	5.19	12.80	-	0	7.62	-	-	0
UAL-MW33	4/4/2001	12.26	4.16	10.95	-	0	8.10	-	-	0
UAL-MW34	4/4/2001	12.33	5.20	NM	4.73	0.47	7.13	7.60	7.46	0
PA-MW1	4/4/2001	NM	6.25	NM	5.75	0.50	-	-	-	0
PA-MW2	4/4/2001	NM	6.70	14.73	-	0	-	-	-	0
PA-MW3	4/4/2001	NM	5.30	10.68	-	0	-	-	-	0
PA-MW4	4/4/2001	NM	NM	NM	-	0	-	-	-	0
PA-MW5	4/4/2001	NM	6.99	13.63	-	0	-	-	-	0

DTW = depth to water
DTB = depth to bottom
DTP = depth to product

J.F.K. International Airport - TWA Terminal 5
UAL Phase II Subsurface Investigation Data
Groundwater Elevation and SPH Gauging Data

April 16, 2001

WELL ID	DATE	CASING ELEVATION (ft)	DTW (ft)	DTB (ft)	DTP (ft)	PRODUCT THICKNESS (ft)	GROUNDWATER ELEVATION (ft)	PRODUCT ELEVATION (ft)	CORRECTED GROUNDWATER ELEVATION (ft)	PRODUCT RECOVERED (ml)
UAL-MW1	4/16/2001	15.12	6.62	13.55	-	0	8.50	-	-	0
UAL-MW2	4/16/2001	13.89	5.82	12.60	5.76	0.06	8.07	8.13	8.11	0
UAL-MW3	4/16/2001	13.81	5.60	NM	4.89	0.71	8.21	8.92	8.71	0
UAL-MW4	4/16/2001	15.55	6.74	NM	6.34	0.40	8.81	9.21	9.09	0
UAL-MW5	4/16/2001	15.05	5.98	13.70	-	0	9.07	-	-	0
UAL-MW6	4/16/2001	15.98	6.18	14.65	6.16	0.02	9.80	9.82	9.81	0
UAL-MW7	4/16/2001	16.07	NM	13.60	-	NM	NM	-	-	0
UAL-MW8	4/16/2001	15.17	5.70	14.70	-	0	9.47	-	-	0
UAL-MW9	4/16/2001	13.74	4.16	12.70	-	0	9.58	-	-	0
UAL-MW10	4/16/2001	13.37	5.29	12.70	-	0	8.08	-	-	0
UAL-MW11	4/16/2001	13.25	5.45	12.95	-	0	7.80	-	-	0
UAL-MW12	4/16/2001	12.93	4.84	13.80	-	0	8.09	-	-	0
UAL-MW13	4/16/2001	13.02	4.50	11.20	-	0	8.52	-	-	0
UAL-MW14	4/16/2001	12.83	5.43	8.65	-	0	7.40	-	-	0
UAL-MW15	4/16/2001	13.68	4.58	13.60	-	0	9.11	-	-	0
UAL-MW16	4/16/2001	11.83	2.96	9.54	-	0	8.87	-	-	0
UAL-MW17	4/16/2001	12.13	3.44	12.20	-	0	8.69	-	-	0
UAL-MW18	4/16/2001	12.40	3.38	13.75	-	0	9.02	-	-	0
UAL-MW19	4/16/2001	14.03	4.45	14.40	-	0	9.58	-	-	0
UAL-MW20	4/16/2001	15.42	5.97	12.60	-	0	9.45	-	-	0
UAL-MW21	4/16/2001	14.83	4.97	12.80	-	0	9.86	-	-	0
UAL-MW22	4/16/2001	15.57	6.39	14.65	-	0	9.18	-	-	0
UAL-MW23	4/16/2001	14.47	5.03	12.65	-	0	9.44	-	-	0
UAL-MW24	4/16/2001	14.53	6.90	13.65	5.87	1.03	7.63	8.66	8.35	0
UAL-MW25	4/16/2001	13.27	4.71	11.92	-	0	8.56	-	-	0
UAL-MW26	4/16/2001	13.04	4.43	12.62	-	0	8.61	-	-	0
UAL-MW27	4/16/2001	15.12	5.95	12.60	-	0	9.17	-	-	0
UAL-MW28	4/16/2001	15.18	6.39	14.67	-	0	8.79	-	-	0
UAL-MW29	4/16/2001	14.48	5.49	13.66	-	0	8.99	-	-	0
UAL-MW30	4/16/2001	15.79	6.01	14.65	-	0	9.78	-	-	0
UAL-MW31	4/16/2001	12.12	4.51	12.70	-	0	7.61	-	-	0
UAL-MW32	4/16/2001	12.81	5.56	12.80	-	0	7.25	-	-	0
UAL-MW33	4/16/2001	12.26	4.04	10.95	4.03	0.01	8.22	8.23	8.23	0
UAL-MW34	4/16/2001	12.33	5.19	NM	4.60	0.59	7.14	7.73	7.55	0
PA-MW1	4/16/2001	NM	5.69	NM	5.65	0.04	-	-	-	0
PA-MW2	4/16/2001	NM	6.54	14.73	-	0	-	-	-	0
PA-MW3	4/16/2001	NM	5.19	10.66	-	0	-	-	-	0
PA-MW4	4/16/2001	NM	-	NM	-	0	-	-	-	0
PA-MW5	4/16/2001	NM	6.85	13.80	-	0	-	-	-	0

DTW = depth to water
DTB = depth to bottom
DTP = depth to product

J.F.K. International Airport - TWA Terminal 5
UAL Phase II Subsurface Investigation Data
Groundwater Elevation and SPH Gauging Data

May 4, 2001

WELL ID	DATE	CASING ELEVATION (ft)	DTW (ft)	DTB (ft)	DTP (ft)	PRODUCT THICKNESS (ft)	GROUNDWATER ELEVATION (ft)	PRODUCT ELEVATION (ft)	CORRECTED GROUNDWATER ELEVATION (ft)	PRODUCT RECOVERED (ml)
UAL-MW1	5/4/2001	15.12	6.60	13.55	-	0	8.52	-	-	0
UAL-MW2	5/4/2001	13.89	5.82	12.60	5.62	0.20	8.07	8.27	8.21	0
UAL-MW3	5/4/2001	13.81	5.49	NM	4.83	0.66	8.32	8.98	8.78	0
UAL-MW4	5/4/2001	15.55	6.70	NM	6.32	0.38	8.85	9.23	9.12	0
UAL-MW5	5/4/2001	15.05	6.26	13.70	-	0	8.79	-	-	0
UAL-MW6	5/4/2001	15.98	6.58	14.65	6.54	0.04	9.40	9.44	9.43	0
UAL-MW7	5/4/2001	16.07	NM	13.60	-	0	NM	-	-	0
UAL-MW8	5/4/2001	15.17	5.81	14.70	-	0	9.36	-	-	0
UAL-MW9	5/4/2001	13.74	4.48	12.70	-	0	9.26	-	-	0
UAL-MW10	5/4/2001	13.37	5.32	12.70	-	0	8.05	-	-	0
UAL-MW11	5/4/2001	13.25	5.48	12.95	-	0	7.77	-	-	0
UAL-MW12	5/4/2001	12.93	4.86	13.80	-	0	8.07	-	-	0
UAL-MW13	5/4/2001	13.02	5.78	11.20	5.51	0.27	7.24	-	-	0
UAL-MW14	5/4/2001	12.83	5.59	8.65	-	0	7.24	-	-	0
UAL-MW15	5/4/2001	13.69	5.09	13.60	-	0	8.60	-	-	0
UAL-MW16	5/4/2001	11.83	3.45	9.54	-	0	8.38	-	-	0
UAL-MW17	5/4/2001	12.13	3.76	12.20	-	0	8.37	-	-	0
UAL-MW18	5/4/2001	12.40	4.16	13.75	-	0	8.24	-	-	0
UAL-MW19	5/4/2001	14.03	4.52	14.40	-	0	9.51	-	-	0
UAL-MW20	5/4/2001	16.42	5.93	12.60	-	0	9.49	-	-	0
UAL-MW21	5/4/2001	14.83	5.27	12.80	-	0	9.56	-	-	0
UAL-MW22	5/4/2001	15.57	6.42	14.85	-	0	9.15	-	-	0
UAL-MW23	5/4/2001	14.47	5.14	12.65	5.10	0.04	9.33	-	-	0
UAL-MW24	5/4/2001	14.53	6.78	13.65	5.80	0.98	7.75	8.73	8.44	0
UAL-MW25	5/4/2001	13.27	5.07	11.92	-	0	8.20	-	-	0
UAL-MW26	5/4/2001	13.04	4.41	12.62	-	0	8.63	-	-	0
UAL-MW27	5/4/2001	15.12	5.90	12.60	-	0	9.22	-	-	0
UAL-MW28	5/4/2001	15.18	6.32	14.67	-	0	8.86	-	-	0
UAL-MW29	5/4/2001	14.46	5.36	13.66	-	0	9.12	-	-	0
UAL-MW30	5/4/2001	15.79	6.40	14.65	-	0	9.39	-	-	0
UAL-MW31	5/4/2001	12.12	4.81	12.70	-	0	7.31	-	-	0
UAL-MW32	5/4/2001	12.81	5.41	12.60	-	0	7.40	-	-	0
UAL-MW33	5/4/2001	12.26	4.41	10.95	-	0	7.85	-	-	0
UAL-MW34	5/4/2001	12.33	5.81	NM	4.88	0.93	6.52	7.45	7.17	0
PA-MW1	5/4/2001	NM	5.60	NM	5.70	0.10	-	-	-	0
PA-MW2	5/4/2001	NM	6.47	14.73	-	0	-	-	-	0
PA-MW3	5/4/2001	NM	5.57	10.68	-	0	-	-	-	0
PA-MW4	5/4/2001	NM	NM	NM	-	0	-	-	-	0
PA-MW5	5/4/2001	NM	6.60	13.83	-	0	-	-	-	0

DTW = depth to water
DTB = depth to bottom
DTP = depth to product

J.F.K. International Airport - TWA Terminal 5
UAL Phase II Subsurface Investigation Data
Groundwater Elevation and SPH Gauging Data

May 16, 2001

WELL ID	DATE	CASING ELEVATION (ft)	DTW (ft)	DTB (ft)	DTP (ft)	PRODUCT THICKNESS (ft)	GROUNDWATER ELEVATION (ft)	PRODUCT ELEVATION (ft)	CORRECTED GROUNDWATER ELEVATION (ft)	PRODUCT RECOVERED (ml)
UAL-MW1	5/18/2001	15.12	6.55	13.55	-	0	8.57	-	-	0
UAL-MW2	5/18/2001	13.89	5.78	12.60	5.57	0.21	8.11	8.32	8.26	0
UAL-MW3	5/18/2001	13.81	5.57	NM	4.85	0.72	8.24	8.96	8.74	0
UAL-MW4	5/18/2001	15.55	6.38	NM	6.28	0.10	9.17	9.27	9.24	0
UAL-MW5	5/18/2001	15.05	6.44	13.70	-	0	8.61	-	-	0
UAL-MW6	5/18/2001	15.98	NM	14.85	NM	NM	NM	-	-	0
UAL-MW7	5/18/2001	16.07	6.90	13.60	-	0	9.17	-	-	0
UAL-MW8	5/18/2001	15.17	5.94	14.70	-	0	9.23	-	-	0
UAL-MW9	5/18/2001	13.74	4.64	12.70	-	0	9.10	-	-	0
UAL-MW10	5/18/2001	13.37	5.32	12.70	-	0	8.05	-	-	0
UAL-MW11	5/18/2001	13.25	5.50	12.95	-	0	7.75	-	-	0
UAL-MW12	5/18/2001	12.93	4.89	13.80	-	0	8.04	-	-	0
UAL-MW13	5/18/2001	13.02	5.90	11.20	5.56	0.35	7.12	7.47	7.37	0
UAL-MW14	5/18/2001	12.83	5.80	8.65	-	0	7.03	-	-	0
UAL-MW15	5/18/2001	13.69	5.27	13.60	-	0	8.42	-	-	0
UAL-MW16	5/18/2001	11.83	3.63	9.54	-	0	8.20	-	-	0
UAL-MW17	5/18/2001	12.13	3.90	12.20	-	0	8.23	-	-	0
UAL-MW18	5/18/2001	12.40	4.37	13.75	-	0	8.03	-	-	0
UAL-MW19	5/18/2001	14.03	4.65	14.40	-	0	9.38	-	-	0
UAL-MW20	5/18/2001	15.42	6.05	12.60	-	0	9.37	-	-	0
UAL-MW21	5/18/2001	14.63	NM	12.80	-	0	NM	-	-	0
UAL-MW22	5/18/2001	15.57	6.49	14.65	-	0	9.08	-	-	0
UAL-MW23	5/18/2001	14.47	5.40	12.65	5.06	0.34	9.07	9.41	9.31	0
UAL-MW24	5/18/2001	14.53	6.74	13.85	5.79	0.95	7.79	8.74	8.46	0
UAL-MW25	5/18/2001	13.27	5.15	11.92	-	0	8.12	-	-	0
UAL-MW26	5/18/2001	13.04	4.41	12.02	-	0	8.63	-	-	0
UAL-MW27	5/18/2001	15.12	5.95	12.60	-	0	9.17	-	-	0
UAL-MW28	5/18/2001	15.18	6.33	14.67	-	0	8.85	-	-	0
UAL-MW29	5/18/2001	14.48	5.48	13.65	-	0	9.00	-	-	0
UAL-MW30	5/18/2001	15.79	6.58	14.65	-	0	9.21	-	-	0
UAL-MW31	5/18/2001	12.12	5.01	12.70	-	0	7.11	-	-	0
UAL-MW32	5/18/2001	12.81	5.64	12.80	-	0	7.17	-	-	0
UAL-MW33	5/18/2001	12.26	4.62	10.95	-	0	7.64	-	-	0
UAL-MW34	5/18/2001	12.33	6.03	NM	5.03	1.00	6.30	7.30	7.00	0
PA-MW1	5/18/2001	NM	6.16	NM	5.80	0.36	-	-	-	0
PA-MW2	5/18/2001	NM	NM	14.73	-	0	-	-	-	0
PA-MW3	5/18/2001	NM	5.74	10.68	-	0	-	-	-	0
PA-MW4	5/18/2001	NM	NM	NM	-	0	-	-	-	0
PA-MW5	5/18/2001	NM	6.75	13.83	-	0	-	-	-	0

DTW = depth to water
DTB = depth to bottom
DTP = depth to product

J.F.K. International Airport - TWA Terminal 5
UAL Phase II Subsurface Investigation Data
Groundwater Elevation and SPH Gauging Data

June 1, 2001

WELL ID	DATE	CASING ELEVATION (ft)	DTW (ft)	DTB (ft)	DTP (ft)	PRODUCT THICKNESS (ft)	GROUNDWATER ELEVATION (ft)	PRODUCT ELEVATION (ft)	CORRECTED GROUNDWATER ELEVATION (ft)	PRODUCT RECOVERED (ml)
UAL-MW1	6/1/2001	15.12	6.56	13.55	-	0	8.56	-	-	0
UAL-MW2	6/1/2001	13.89	5.82	12.60	5.57	0.25	8.07	8.32	8.25	0
UAL-MW3	6/1/2001	13.81	5.60	NM	4.87	0.73	8.21	8.94	8.72	0
UAL-MW4	6/1/2001	15.55	6.94	NM	6.42	0.52	8.61	9.13	8.97	0
UAL-MW5	6/1/2001	15.05	6.43	13.70	-	0	8.62	-	-	0
UAL-MW6	6/1/2001	15.98	7.26	14.65	6.72	0.54	8.72	9.26	9.10	0
UAL-MW7	6/1/2001	16.07	6.94	13.60	-	0	9.13	-	-	0
UAL-MW8	6/1/2001	15.17	5.96	14.70	-	0	9.22	-	-	0
UAL-MW9	6/1/2001	13.74	4.55	12.70	-	0	9.19	-	-	0
UAL-MW10	6/1/2001	13.37	5.24	12.70	-	0	8.13	-	-	0
UAL-MW11	6/1/2001	13.25	5.48	12.95	-	0	7.77	-	-	0
UAL-MW12	6/1/2001	12.93	4.81	13.80	-	0	8.12	-	-	0
UAL-MW13	6/1/2001	13.02	5.86	11.20	5.52	0.34	7.16	7.50	7.40	0
UAL-MW14	6/1/2001	12.83	5.79	8.65	-	0	7.04	-	-	0
UAL-MW15	6/1/2001	13.69	5.04	13.60	-	0	8.65	-	-	0
UAL-MW16	6/1/2001	11.83	3.39	9.54	-	0	8.44	-	-	0
UAL-MW17	6/1/2001	12.13	3.74	12.20	-	0	8.39	-	-	0
UAL-MW18	6/1/2001	12.40	4.27	13.75	-	0	8.13	-	-	0
UAL-MW19	6/1/2001	14.03	4.76	14.40	-	0	9.27	-	-	0
UAL-MW20	6/1/2001	15.42	6.16	12.60	-	0	9.26	-	-	0
UAL-MW21	6/1/2001	14.83	5.56	12.60	-	0	9.27	-	-	0
UAL-MW22	6/1/2001	15.57	6.55	14.65	-	0	9.02	-	-	0
UAL-MW23	6/1/2001	14.47	5.62	12.65	5.14	0.48	8.85	9.33	9.19	0
UAL-MW24	6/1/2001	14.53	6.80	13.65	5.80	1.00	7.73	8.73	8.43	0
UAL-MW25	6/1/2001	13.27	4.90	11.92	-	0	8.37	-	-	0
UAL-MW26	6/1/2001	13.04	4.40	12.62	-	0	8.64	-	-	0
UAL-MW27	6/1/2001	15.12	6.02	12.60	-	0	9.10	-	-	0
UAL-MW28	6/1/2001	15.18	6.37	14.67	-	0	8.81	-	-	0
UAL-MW29	6/1/2001	14.48	4.58	13.65	-	0	9.90	-	-	0
UAL-MW30	6/1/2001	15.79	5.65	14.65	-	0	10.14	-	-	0
UAL-MW31	6/1/2001	12.12	4.91	12.70	-	0	7.21	-	-	0
UAL-MW32	6/1/2001	12.81	5.50	12.60	-	0	7.31	-	-	0
UAL-MW33	6/1/2001	12.26	4.56	10.95	-	0	7.70	-	-	0
UAL-MW34	6/1/2001	12.33	6.00	NM	4.94	1.06	6.33	7.39	7.07	0
PA-MW1	6/1/2001	NM	6.51	NM	5.85	0.66	-	-	-	0
PA-MW2	6/1/2001	NM	NM	14.73	-	0	-	-	-	0
PA-MW3	6/1/2001	NM	5.58	10.68	-	0	-	-	-	0
PA-MW4	6/1/2001	NM	NM	NM	-	0	-	-	-	0
PA-MW5	6/1/2001	NM	6.75	13.83	-	0	-	-	-	0

DTW = depth to water
DTB = depth to bottom
DTP = depth to product

J.F.K. International Airport - TWA Terminal 5
UAL Phase II Subsurface Investigation Data
Groundwater Elevation and SPH Gauging Data

August 21, 2001

WELL ID	DATE	CASING ELEVATION (ft)	DTW (ft)	DTB (ft)	DTP (ft)	PRODUCT THICKNESS (ft)	GROUNDWATER ELEVATION (ft)	PRODUCT ELEVATION (ft)	CORRECTED GROUNDWATER ELEVATION (ft)	PRODUCT RECOVERED (ml)
UAL-MW1	8/21/2001	15.12	6.88	13.55	-	0	8.24	-	-	0
UAL-MW2	8/21/2001	13.89	5.76	12.60	6.39	0.63	8.13	7.50	8.67	0
UAL-MW3	8/21/2001	13.81	5.15	NM	6.37	1.22	8.66	7.44	9.51	0
UAL-MW4	8/21/2001	15.55	6.65	NM	7.63	0.98	8.90	7.92	9.59	0
UAL-MW5	8/21/2001	15.05	6.83	13.79	-	0	8.22	-	-	0
UAL-MW6	8/21/2001	15.98	6.91	14.65	8.45	1.64	9.07	7.53	10.15	0
UAL-MW7	8/21/2001	16.07	7.40	13.60	-	0	8.67	-	-	0
UAL-MW8	8/21/2001	15.17	6.48	14.70	-	0	8.69	-	-	0
UAL-MW9	8/21/2001	13.74	5.21	12.70	-	0	8.53	-	-	0
UAL-MW10	8/21/2001	13.37	5.64	12.70	-	0	7.73	-	-	0
UAL-MW11	8/21/2001	13.25	5.74	12.95	-	0	7.51	-	-	0
UAL-MW12	8/21/2001	12.93	6.16	13.60	-	0	6.77	-	-	0
UAL-MW13	8/21/2001	13.02	5.77	11.20	6.16	0.39	7.25	6.86	7.52	0
UAL-MW14	8/21/2001	12.83	6.17	8.65	-	0	6.66	-	-	0
UAL-MW15	8/21/2001	13.89	5.85	13.60	-	0	8.04	-	-	0
UAL-MW16	8/21/2001	11.83	3.93	9.54	-	0	7.90	-	-	0
UAL-MW17	8/21/2001	12.13	4.21	12.20	-	0	7.92	-	-	0
UAL-MW18	8/21/2001	12.40	4.77	13.75	-	0	7.63	-	-	0
UAL-MW19	8/21/2001	14.03	5.24	14.40	-	0	8.79	-	-	0
UAL-MW20	8/21/2001	15.42	6.57	12.60	-	0	8.85	-	-	0
UAL-MW21	8/21/2001	14.83	6.00	12.60	-	0	8.83	-	-	0
UAL-MW22	8/21/2001	15.57	6.92	14.65	-	0	8.65	-	-	0
UAL-MW23	8/21/2001	14.47	5.44	12.65	7.03	1.59	9.03	7.44	10.14	0
UAL-MW24	8/21/2001	14.63	6.01	13.65	7.41	1.40	8.62	7.12	9.50	0
UAL-MW25	8/21/2001	13.27	5.36	11.92	-	0	7.91	-	-	0
UAL-MW26	8/21/2001	13.04	4.76	12.62	-	0	8.28	-	-	0
UAL-MW27	8/21/2001	15.12	6.42	12.60	-	0	8.70	-	-	0
UAL-MW28	8/21/2001	15.18	6.72	14.67	-	0	8.46	-	-	0
UAL-MW29	8/21/2001	14.46	5.88	13.65	-	0	8.60	-	-	0
UAL-MW30	8/21/2001	15.79	7.08	14.65	-	0	8.71	-	-	0
UAL-MW31	8/21/2001	12.12	5.39	12.70	-	0	6.73	-	-	0
UAL-MW32	8/21/2001	12.61	6.02	12.60	-	0	6.79	-	-	0
UAL-MW33	8/21/2001	12.26	5.08	10.95	-	0	7.18	-	-	0
UAL-MW34	8/21/2001	12.33	5.32	NM	7.02	1.70	7.01	5.31	8.20	0
PA-MW1	8/21/2001	NM	6.02	NM	8.37	2.35	-	-	-	0
PA-MW2	8/21/2001	NM	6.65	14.73	-	0	-	-	-	0
PA-MW3	8/21/2001	NM	6.04	10.68	-	0	-	-	-	0
PA-MW4	8/21/2001	NM	7.75	NM	-	0	-	-	-	0
PA-MW5	8/21/2001	NM	6.90	13.83	-	0	-	-	-	0

DTW = depth to water
DTB = depth to bottom
DTP = depth to product

September 10, 2001

WELL ID	DATE	CASING ELEVATION (ft)	DTW (ft)	DTB (ft)	DTP (ft)	PRODUCT THICKNESS (ft)	GROUNDWATER ELEVATION (ft)	PRODUCT ELEVATION (ft)	CORRECTED GROUNDWATER ELEVATION (ft)	PRODUCT RECOVERED (ml)
UAL-MW1	9/10/2001	15.12	7.00	13.55	-	-	8.12	-	-	0
UAL-MW2	9/10/2001	13.89	5.86	12.60	-	-	8.03	-	-	0
UAL-MW3	9/10/2001	13.81	6.75	NM	5.21	1.54	7.06	8.60	8.14	0
UAL-MW4	9/10/2001	15.55	8.05	NM	6.86	1.19	7.50	8.69	8.33	0
UAL-MW5	9/10/2001	15.05	6.97	13.70	-	-	8.08	-	-	0
UAL-MW6	9/10/2001	15.98	8.56	14.65	7.12	1.44	7.42	8.86	8.43	0
UAL-MW7	9/10/2001	16.07	7.51	13.60	-	-	8.56	-	-	0
UAL-MW8	9/10/2001	15.17	6.66	14.70	-	-	8.51	-	-	0
UAL-MW9	9/10/2001	13.74	5.36	12.70	-	-	8.38	-	-	0
UAL-MW10	9/10/2001	13.37	5.61	12.70	-	-	7.76	-	-	0
UAL-MW11	9/10/2001	13.25	5.84	12.85	-	-	7.41	-	-	0
UAL-MW12	9/10/2001	12.93	5.20	13.80	-	-	7.73	-	-	0
UAL-MW13	9/10/2001	13.02	5.89	11.20	-	-	7.13	-	-	0
UAL-MW14	9/10/2001	12.83	6.31	8.65	-	-	6.52	-	-	0
UAL-MW15	9/10/2001	13.69	5.84	13.80	-	-	7.85	-	-	0
UAL-MW16	9/10/2001	11.83	4.08	9.54	-	-	7.75	-	-	0
UAL-MW17	9/10/2001	12.13	4.37	12.20	-	-	7.76	-	-	0
UAL-MW18	9/10/2001	12.40	4.91	13.75	-	-	7.49	-	-	0
UAL-MW19	9/10/2001	14.03	5.40	14.40	-	-	8.63	-	-	0
UAL-MW20	9/10/2001	15.42	6.72	12.60	-	-	8.70	-	-	0
UAL-MW21	9/10/2001	14.83	6.15	12.80	-	-	8.68	-	-	0
UAL-MW22	9/10/2001	15.57	7.07	14.65	-	-	8.50	-	-	0
UAL-MW23	9/10/2001	14.47	NM	12.65	5.60	NM	NM	8.97	NM	0
UAL-MW24	9/10/2001	14.53	7.67	13.65	6.11	1.46	6.96	8.42	7.96	0
UAL-MW25	9/10/2001	13.27	5.56	11.92	-	-	7.71	-	-	0
UAL-MW26	9/10/2001	13.04	4.87	12.62	-	-	8.17	-	-	0
UAL-MW27	9/10/2001	15.12	6.56	12.60	-	-	8.56	-	-	0
UAL-MW28	9/10/2001	15.18	6.84	14.67	-	-	8.34	-	-	0
UAL-MW29	9/10/2001	14.48	6.01	13.65	-	-	8.47	-	-	0
UAL-MW30	9/10/2001	15.79	7.26	14.65	-	-	8.53	-	-	0
UAL-MW31	9/10/2001	12.12	5.55	12.70	-	-	6.57	-	-	0
UAL-MW32	9/10/2001	12.81	6.23	12.80	-	-	6.58	-	-	0
UAL-MW33	9/10/2001	12.26	5.29	10.95	-	-	6.97	-	-	0
UAL-MW34	9/10/2001	12.33	5.42	NM	-	-	6.91	-	-	0
PA-MW1	9/10/2001	NM	8.62	NM	6.05	NM	NM	NM	NM	0
PA-MW2	9/10/2001	NM	6.97	14.73	-	-	NM	-	-	0
PA-MW3	9/10/2001	NM	6.25	10.65	-	-	NM	-	-	0
PA-MW4	9/10/2001	NM	NM	NM	-	-	NM	-	-	0
PA-MW5	9/10/2001	NM	7.05	13.83	-	-	NM	-	-	0

APPENDIX 2

Quality Assurance/Quality Control Plan

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1.0 INTRODUCTION

This Quality Assurance Project Plan (QAPP) describes the protocols and procedures that will be followed during implementation of the remediation activities at the Terminal 5 Expansion Site located within the John F. Kennedy International Airport (JFKIA). The objective of the QAPP is to provide for Quality Assurance (QA) and maintain Quality Control (QC) of environmental remediation and sampling activities conducted under the Remedial Action Workplan (RAWP). Adherence to the QAPP will ensure that the selected remedial actions will be performed in compliance with the RAWP and required New York State Department of Environmental Conservation (NYSDEC) regulations, and will also provide defensible data that can be used in petitioning for No Further Action (NFA) designation upon adequate completion of all remedial activities.

2.0 PROJECT TEAM

The Port Authority of New York and New Jersey (PANYNJ) will assign a full time Monitor during the terminal construction to ensure all activities are performed in compliance with this Remedial Action Work Plan. The Port Authority will also be responsible for conducting the Post Construction Baseline as well as the Monitored Natural Attenuation as described in this Remedial Action Work Plan.

3.0 FIELD ACTIVITIES

The following sections describe the field activities that are proposed for the remedial actions and subsequent monitored natural attenuation (MNA) program. The MNA program is proposed to commence upon completion of the active vacuum extraction phase of the remediation activities. The MNA program will include installation of monitoring wells, collecting and handling soil and groundwater samples in the field, measuring field parameters and performing decontamination of sampling and drilling equipment.

3.1. SOIL SCREENING

A photoionization detector (PID) will be used to field screen excavated soils (e.g., soil piles) during the remedial action activities at the site. The soil screening procedure will be as follows:

- Create a nominal one-inch diameter three-inch deep hole in the area to be field screened using a tube-type soil sampler or small diameter hand auger to expose a fresh surface to be screened.
- Place the PID probe in the hole to obtain an organic vapor concentration screening measurement.
- Record sustained PID reading after allowing ten second equilibration period.

3.2. SOIL BORINGS

Soil borings will be drilled as part of the monitoring well installation activities. Soil samples will be collected using two-foot long, 2-inch diameter, split spoon samplers in advance of hollow stem augers. Split spoon samplers will be advanced to the desired depth interval and samples collected as outlined in Section 3.2. Prior to reuse, the split spoon sampler will be decontaminated following the procedures listed in Section 3.6.

3.3. SOIL SAMPLE COLLECTION

Soil sampling will be conducted according to the following procedures:

- Decontaminate split spoon assembly (see Section 3.6).
- Advance sampler to desired interval.

- Retrieve the sampler. Open the split spoon sampler to allow inspection of the soil core.
- Inspect the soil core for visual evidence of contamination including staining, sheens, odor and/or the presence of free-phase petroleum product.
- Create small holes in the core at six-inch intervals using a sampling spoon (or equivalent) and place the PID probe in the hole to obtain an organic vapor concentration screening measurement.
- Characterize the sample according to standardized classification system (e.g., modified Burmister soil classification system).
- After selecting which sample interval will be analyzed in the laboratory, fill the required laboratory-supplied sample jars with the soil from the selected interval. Seal and label the sample jars as described in Section 3.7 and place in an ice-filled cooler.
- Decontaminate any soil sampling equipment between sample locations as described in Section 3.6.
- Record boring number, sample depth and sample observations (evidence of contamination, PID readings, soil classification) in field log book or boring log data sheet, if applicable.

3.4. MONITORING WELL INSTALLATION

Soil boring locations will be converted into monitoring wells, and will be advanced to the desired depth using hollow stem augers and a truck-mounted drill rig. Once reaching the desired depth, monitoring wells will be installed in the boring using two or four-inch diameter PVC well materials according to the following procedure:

- Measure the depth to water in the open hole using an oil/water interface probe.
- Place PVC riser with a minimum of a five -foot length of PVC 0.02-slotted screen at the bottom of the borehole. The screen should be placed such that it bridges the water table, with a minimum of two-feet of well screen extending above the water table. All wells should contain a sump consisting of one foot of solid PVC riser and a bottom cap.
- Install the sand filter pack around the well screen to a depth of one to two feet above the top of the screen.
- Install a bentonite seal to a depth of one to two feet above the filter pack.
- Backfill the remainder of the annular space using a bentonite-cement grout.
- Complete the well with a locking cap flush-with-grade curb box set in cement that is designed for loading rates in accordance with well placement (e.g., aircraft weight loading rates in taxiway). Provide a cement apron around the curb box to direct run-off away from the well.

- Decontaminate the augers prior to and following installation of each well as described in Section 3.6.
- Document well installation data (location, depth, construction details, water level measurements) in the field logbook or on field data sheets.

3.5. MONITORING WELL DEVELOPMENT

Following well installation, all new and existing wells will be developed according to the following procedure:

- Measure the depth to water using an oil/water interface probe and the total depth of the well using a weighted tape. Use these measurements to calculate the length of the water column (total depth minus depth to water). Calculate the volume of water in the well using the following conversion factors:

Well Diameter (inches)	Volume per Foot of Water Column (gallons)
2	0.163
4	0.653
6	1.469

- During development, collect periodic samples and analyze for turbidity and water quality indicators (e.g., pH, temperature, dissolved oxygen, reduction-oxidation potential, and specific conductivity) with measurements collected approximately every five minutes.
- Continue developing the well until turbidity is less than 10 nephelometric turbidity units (NTUs) for three successive readings or until water quality indicators have stabilized to the extent practicable. The criteria for stabilization will be three successive readings within 10% for pH, temperature and specific conductivity. A minimum of three well volumes of water should be removed prior to sampling.
- Document the volume of water removed and any other observations made during well development in the field logbook or on field data sheets.
- Decontaminate the equipment prior to and following development at each well location as described in Section 3.6.

3.6. MONITORING WELL SAMPLING

Groundwater will be allowed to stabilize for a minimum of one week prior to the collection of baseline groundwater samples. Samples will be collected according to the following procedure:

- Remove the locking cap and measure the vapor concentrations in the well with a PID.
- Measure the total well depth, depth to water and check for the presence of light non-aqueous phase liquid (LNAPL) using an oil/water interface probe. Groundwater samples will not be collected from wells containing measurable NAPL (>0.01 foot).
- Use the water level and total well depth measurements to calculate the length of the mid-point of the water column within the screened interval.
- Connect dedicated tubing to either a submersible or bladder pump and lower the pump such that the intake of the pump is set at the mid-point of water column within the screened interval of the well. Connect the discharge end of the tubing to a flow-through cell of a Hydrolab Quanta multi-parameter (or equivalent) meter. Connect tubing to the output of the cell and place the discharge end of the tubing in a 5-gallon bucket.
- Activate the pump at its lowest flow rate setting and record initial field parameters in flow through cell.
- Measure the depth to water within the well. The pump flow rate may be increased such that the water level measurements do not change by more than 0.3 feet as compared to the initial static reading.
- During purging, record periodic water quality indicator (e.g., turbidity, pH, temperature, dissolved oxygen, reduction-oxidation potential, salinity, and specific conductivity) measurements (approximately every five minutes).
- Continue purging the well until turbidity and water quality indicators have stabilized to the extent practicable. The criteria for stabilization will be three successive readings for the following parameters and criteria:

Parameter	Stabilization Criteria
pH	+/- 0.1 pH units
Specific Conductance	+/- 3% S/cm
ORP/Eh	+/- 10mV
Turbidity	+/- 10% NTUs (for values > 1 NTU)
Dissolved Oxygen	+/- 0.3 mg/l

- If the water quality parameters do not stabilize prior to purging three to five well volumes of water, purging may be discontinued. Efforts to stabilize the water quality for the well must be recorded in the field book, and samples may then be collected as described below.

- After purging, disconnect the tubing to the inlet of the flow-through cell. Collect groundwater samples directly from the discharge end of the tubing and place into the required sample containers. Label the containers as described in Section 4.7 and place in an ice-filled cooler. Samples should be collected first for VOCs, SVOCs, TPHC, alkalinity, sulfates, nitrate, ferrous iron, dissolved iron and manganese.
- Collect one final field sample and analyze for turbidity and water quality parameters (e.g., pH, temperature, dissolved oxygen, reduction-oxidation potential, salinity and specific conductivity).
- Once sampling is complete, remove the pump and tubing from the well. Disconnect the tubing and place it back in the well for reuse during the next sampling event.
- Decontaminate the pump, oil/water interface probe, flow-through cell, and plastic filter chamber as described in Section 3.6.
- Record all measurements (depth to water, depth to NAPL, water quality parameters, turbidity), calculations (well volume) and observations in the project logbook and field data sheet, if applicable.

3.7. DECONTAMINATION PROCEDURES

Decontamination will be conducted on plastic sheeting or other containment unit that is bermed to prevent runoff to the ground. Prior to use on-site and between sampling locations, the split spoon samplers, pump, oil/water interface probe, and other non-disposable equipment that contacts the sample will be decontaminated using the following procedures:

1. Scrub using tap water/Alconox® or Simple Green® mixture and bristle brush.
2. Double rinse with generous amount of tap water.
3. Final rinse with distilled water.
4. Air dry

The down hole drilling equipment will be decontaminated with a steam cleaner.

3.8. SAMPLE HANDLING

3.8.1. Sample Identification

All samples will be consistently identified in all field documentation, chain-of-custody documents and laboratory reports using an alpha-numeric code system. All samples will be identified with a prefix of "T5" to designate the Terminal 5 Expansion Site. Groundwater

samples will be identified by the monitoring well number and soil boring samples will be identified by the soil boring number followed by the sample depth interval (in parenthesis).

The designation "MS" will be added at the end of the designation for matrix spike/matrix spike duplicate samples. The field duplicate samples will be labeled with a fictitious sample location to ensure that they are submitted as blind samples to the laboratory. For duplicate soil boring samples, the sample depth will be the actual sample depth interval. Trip blanks and field blanks will be identified with "TB" and "FB", respectively.

The following table provides examples of the sampling identification scheme:

Sample Description	Sample Designation
Soil sample collected from 5 to 7 feet at SB-3	T5-SB-3 (5-7)
Groundwater sample collected from monitoring well MW-5	T5-MW-5
MS/MSD duplicate sample from MW-8	T5-MW-8-MS

3.8.2. Sample Labeling and Shipping

All sample containers will be provided with labels containing the following information:

- Project identification
- Sample identification
- Date and time of collection
- Analysis(es) to be performed
- Samplers initials

Once the samples are collected and labeled, they will be placed in ice-filled coolers and stored in a cool area away from direct sunlight to await shipment to the laboratory. At the start and end of each workday, field personnel will add ice to the coolers as needed.

3.8.3. Sample Custody

Field personnel will be responsible for maintaining the sample coolers in a secured location until they are delivered to or picked up by the laboratory. The record of possession of samples from the time they are obtained in the field to the time they are relinquished to the laboratory or shipped off-site will be documented on chain-of-custody (COC) forms. The COC forms will contain the following information: project name; names of sampling personnel; sample number; date and time of collection and matrix; and signatures of individuals involved in sample transfer, and the dates and times of transfers. Laboratory personnel will note the condition of the custody seal at sample check-in.

3.9. FIELD INSTRUMENTATION

Field personnel will be trained in the proper operation of all field instruments at the start of the field program. Instruction manuals for the equipment will be on file at the site for referencing proper operation, maintenance and calibration procedures.

The equipment will be calibrated according to manufacturer specifications at the start of each day of fieldwork. If an instrument fails calibration, the project manager or QA/QC officer will be contacted immediately to obtain a replacement instrument and arrange for repairs. A calibration log will be maintained to record the date of each calibration, any failure to calibrate and corrective actions taken. The PID will be calibrated each day using 100 parts per million (ppm) isobutylene span gas.

4.0 LABORATORY PROCEDURES

4.1. LABORATORY METHODS

Table 1 summarizes the laboratory methods that are anticipated for analyses of field samples as well as the sample container type, preservation, and applicable holding times. All sample analyses will be performed in a New York State Department of Health Environmental Laboratory Approval Program (NYSDOH-ELAP) laboratory certified to perform NYSDEC Analytical Services Protocol (ASP). The laboratory will produce Category B, or equivalent deliverables.

4.2. QUALITY CONTROL SAMPLING

In addition to the laboratory analysis of the field soil and groundwater samples, additional analysis will be included for quality control measures. These samples will include one equipment rinsate blank (when dedicated equipment is not used), one trip blank (aqueous samples only), one matrix spike/matrix spike duplicate (MS/MSD) and one set of duplicate samples per twenty field samples or per sample shipment, whichever includes fewer samples. The equipment blank, MS/MSD and duplicate samples will be analyzed for TCL VOCs, TCL SVOCs, TAL metals, and cyanide. The trip blank will be analyzed for VOCs. Table 2 summarizes field quality control sampling.

5.0 DATA REVIEW

The Project Manager, or designated competent personnel, will conduct a review of all analytical data and prepare a Data Usability Summary Report (DUSR) to assess the quality of the data and determine its usability. To assess the data, the QA/QC officer will:

- Ensure the data package is complete as defined under the requirements for the NYSDEC ASP Category B or USEPA CLP deliverables and that all data were generated using established and agreed upon protocols.
- Check that all holding times were met.
- Check that all QC data (blanks, instrument tunings, calibration standards, calibration verifications, surrogate recoveries, spike recoveries, replicate analyses, laboratory controls and sample data) fall within the protocol required limits and specifications.
- Compare raw data with results provided in the data summary sheets and quality control verification forms.
- Check that correct data qualifiers were used.
- Evaluate of NYSDEC ASP Matrix Spike Blank (MSB) data and qualify the data in accordance with ASP or EPA Region 2 Data Validation Guidelines.

Any Quality Control exceedances will be numerically specified in the DUSR, and the corresponding data package QC summary sheet identifying the exceedances will be attached. The DUSR will identify any data deficiencies, analytical protocol deviations and quality control problems and discuss their effect on the data. Recommendations for re-sampling and/or re-analysis will be made. All data that would be rejected by the EPA Region 2 Data Validation Guidelines will also be rejected in the DUSR. All data qualifications will be documented following the NYSDEC ASP guidelines or the EPA Region 2 data validation guidelines.

TABLES

APPENDIX 3

Site specific State Pollution Discharge Elimination System Requirements

State Pollutant Discharge Elimination System (SPDES)

DISCHARGE PERMIT

Special Conditions (Part I)

Industrial Code: 5171
Discharge Class (CL): 01
Toxic Class (TX): T
Major Drainage Basin: 17
Sub Drainage Basin: 01
Water Index Number: L.I. 247 &
Compact Area: ISC

SPDES Number: NY-0006109
DEC Number: 2-6308-00019/00016-0
Effective Date (EDP): 11/01/87
Expiration Date (ExDP): 10/31/92
Modification Date(s): 9/28/93, 4/14/94
Attachment(s): General Conditions (Part II) Date: 02/85

This SPDES permit is issued in compliance with Title 8 of Article 17 of the Environmental Conservation Law of New York State and in compliance with the Clean Water Act as amended, (33 U.S.C. Section 1251 et. seq.) (hereafter referred to as "the Act").

PERMITTEE NAME AND ADDRESS

Attention: Eugene Pesullo, Dir. of Eqr

Name: Port Authority of New York and New Jersey
Street: One World Trade Center - Room 72 South
City: New York State: NY Zip Code: 10048
is authorized to discharge from the facility described below:

FACILITY NAME AND ADDRESS

Name: John F. Kennedy International Airport
Location (C,T,V): New York County: Queens
Facility Address: One World Trade Center - Room 72 South
City: New York State: NY Zip Code: 10048
NYTM - E: NYTM - N: 4
From Outfall No.: 003 at Latitude: 40° 38' 30" & Longitude: 73° 46' 40"
into receiving waters known as: Bergen Basin Class: I
and: (list other Outfalls, Receiving Waters & Water Classifications)

004, 10A, 10C, 10D - Jamaica Bay Class: SB
025 - Groundwater Class: GA
KP1-KP5 Jamaica Bay (via 010) Class: SB

in accordance with the effluent limitations, monitoring requirements and other conditions set forth in Special Conditions (Part I) and General Conditions (Part II) of this permit.

DISCHARGE MONITORING REPORT (DMR) MAILING ADDRESS

Mailing Name: Port Authority of New York and New Jersey
Street: One World Trade Center - Room
City: New York State: NY Zip Code: 10048
Responsible Official or Agent: Richard Louis, Super. A/P Main Phone: (718)244-3551

This permit and the authorization to discharge shall expire on midnight of the expiration date shown and the permittee shall not discharge after the expiration date unless this permit has been renewed, or extended pursuant to law. To be authorized to discharge beyond the expiration date, the permittee shall apply for a permit renewal no less than 180 days prior to the expiration date shown above.

DISTRIBUTION: Richard Newman, Reg. 2
Robert Hannaford, Central Office

Permit Administrator: John J. Ferguson
Address: 47-40 21st St., Long Island City, New York 11101
Signature: Michelle M. Moore for
Date: 4 / 14 / 94

91-20-2a (1/89)

SPDES No: NY 000 8102

Part 1, Page 2 of 9

MODIFIED

FINAL EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

During the period beginning October 1, 1987

and lasting until October 1, 1992

the discharges from the permitted facility shall be limited and monitored by the permittee as specified below:

Outfall Number & Effluent Parameter	Discharge Limitations Daily Avg.	Daily Max.	Units	Minimum Monitoring Requirements Measurement Frequency	Sample Type
KP3 - KIAC Waste Heat Steam & Generator Blowdown					
Flow	Monitor	Monitor	MGD	Monthly	Instantaneous
Temperature	NA	150[2]	°F	Monthly	Grab
Oil & Grease	NA	15	mg/l	Monthly	Grab
pH (Range)	6.0 - 9.0		SU's	Monthly	Grab
Solids, Total Suspended	NA	50	mg/l	Monthly	Grab
KP4 - KIAC Cooling tower Blowdown					
Flow	Monitor	Monitor	GPD	Monthly	Instantaneous
Temperature	NA	90	°F	Monthly	Grab
pH (Range)	6.0 - 9.0		SU's	Monthly	Grab
Oil & Grease	NA	15	mg/l	Monthly	Grab
Chlorine, Free Available	0.2	0.5	mg/l	Weekly	Grab
Chromium, Total	NA	0.2	mg/l	Monthly	Grab
Copper, Total	NA	0.8	mg/l	Monthly	Grab
Zinc, Total	NA	1.0	mg/l	Monthly	Grab
KP5 - KIAC Cooling tower Blowdown					
Flow	Monitor	Monitor	GPD	Monthly	Instantaneous
Temperature	NA	90	°F	Monthly	Grab
pH (Range)	6.0 - 9.0		SU's	Monthly	Grab
Oil & Grease	NA	15	mg/l	Monthly	Grab
Chlorine, Free Available	0.2	0.5	mg/l	Weekly	Grab
Chromium, Total	NA	0.2	mg/l	Monthly	Grab
Copper, Total	NA	0.8	mg/l	Monthly	Grab
Zinc, Total	NA	1.0	mg/l	Monthly	Grab

[2] The water temperature at the surface of Jamaica Bay shall not be raised to more than 32.2°C (90 °F) at any point. Further, in at least 80 percent of the cross-sectional areas in Jamaica Bay including at least a minimum of 1/3 of the surface measured from shore to shore shall not be raised to more than 2.8°C (5 °F) at any point over the temperature that existed before the addition of heat of artificial origin or to a maximum of 30.0°C (86°F), whichever is less.

91-20-2a (1/89)

SPDES No.: NY 000 8109

Part 1, Page 3 of 9

MODIFIED

FINAL EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

During the period beginning October 1, 1987

and lasting until October 1, 1992

the discharges from the permitted facility shall be limited and monitored by the permittee as specified below:

Outfall Number & Effluent Parameter	Discharge Limitations Daily Avg.	Daily Max.	Units	Minimum Monitoring Requirements Measurement Frequency	Sample Type
003, 004, 10A, 10C, [redacted] (Oil/Water Separators)					
Flow	Monitor	Monitor	GPD	Monthly	Instantaneous
Oil & Grease	NA	15	mg/l	Monthly	Grab[1]
pH (Range)	6.0 - 9.0		SU	Monthly	Grab
Suspended Solids	30	45	mg/l	Monthly	Grab
025 - JFK, GSA-Bldg. 111 Non-Contact Cooling Water					
Flow	Monitor	0.11	MGD	Monthly	Instantaneous
Temperature	NA	90	°F	Monthly	Grab
Oil & Grease	NA	15	mg/l	Monthly	Grab
pH (Range)	6.5 - 8.5		SU's	Monthly	Grab
Chlorine, Total Residual	NA	0.2	mg/l	Monthly	Grab
KP1 - KIAC Floor Drain from hi-pressure BFW pump area & liquid fuel skid drain					
Flow	Monitor	Monitor	GPD	Monthly	Instantaneous
Oil & Grease	NA	15	mg/l	Monthly	Grab
pH (Range)	6.0 - 9.0		SU	Monthly	Grab
KP2- KIAC Natural gas compressor skid area storm water					
Flow	Monitor	Monitor	GPD	Monthly	Instantaneous
pH (Range)	6.0 - 9.0		SU's	Monthly	Grab
Oil & Grease	NA	15	mg/l	Monthly	Grab

[1] One, two, or three samples may be collected and analyzed per sampling event. The samples will be grab samples obtained at 15 minute intervals with the primary samples collected during the first 15 minutes of discharge. If more than one grab sample is collected and analyzed per sampling event, the number reported will be the arithmetic average of the separate analyses.

SPDES No.: NY 000 8109

Part 1, Page 4 of 9

MODIFIED:

PROHIBITIONS:

No industrial or manufacturing process wastewater effluents; with the exception of cooling tower or boiler blowdown wastewaters are permitted, including wastewaters resulting from vehicle maintenance or washing operations.

Waste or wastewater generated at locations other than at this facility are not permitted to be treated at or discharged from this facility.

Special Condition:

By the latter of September 1, 1994 or 60 days after initial commercial operation of the KIAC cogeneration plant, KIAC Partners shall submit to the Department a plan for a study of reasonably available biofouling control techniques, procedures and Best Management Practices which may be utilized consistent with the existing facility's design and construction to minimize Total Residual Chlorine levels in the cooling tower discharges (KP4 & KP5). Such techniques etc... may include by way of example, variations in the quantity and type of biofouling control chemicals used, application methods and the like.

The plan for the chlorine minimization study shall include but not be limited to: a summary of the various techniques; procedures and practices to be tried; the test methods to be employed; a schedule for conducting the study.

By the latter of April 1, 1995 or one year after initial commercial operation of the KIAC cogeneration plant, KIAC Partners shall submit to the Department a Final Report[3] summarizing results of the study and a schedule for implementing the selected chlorine minimization practice or practices.

Implementation of the chosen operational chlorine minimization practices shall be completed on or before July 1, 1995.

The Plan and Final Report required pursuant to this Special condition shall be submitted to the attention of:

Richard Newman, RWE
NYS-DEC - Region-2
1 Hunters Point Plaza
4740 21st. Street
Long Island City, N.Y. 11101-5407

NOTES:

A visual check for oil or floating substances must be made and logged prior to the initiation of any discharge. The log of visual observations shall be maintained at the facility for a period of at least three years and must be made available to department personnel upon request.

There shall be no discharge of Polychlorinated biphenyl compounds from this facility.

Any Chemical additives proposed for use at this facility must be approved by this Department prior to use. Chemical additives specified in this application may be used and shall not cause or contribute to a violation of water quality standards.

Any Engineering Reports, Plans and Specifications Submitted to this Department must bear the Stamp and signature of the New York Registered Professional Engineer responsible for the design.

[3] In addition to the report, KIAC may submit information such as, archival or current operational practices and sampling results to buttress arguments put forward in the Final Report.

91-20-2g (2/69)

SPDES No.: NY 000 8109

Part 1, Page 5 of 9

MODIFIED:

ACTION LEVEL REQUIREMENTS (TYPE I)

The parameters listed below have been reported present in the discharge but at levels that currently do not require water quality or technology based limits. Action levels have been established which, if exceeded, will result in reconsideration or water quality or technology based limits.

Routine action level monitoring results, if not provided for on the Discharge Monitoring Report (DMR) form, shall be appended to the DMR for the period during which the sampling was conducted. If submission of DMR's is not required by this permit, the results shall be maintained in accordance with instructions on the RECORDING, REPORTING AND MONITORING page of this permit.

If any of the action levels is exceeded, the permittee shall undertake a short-term, high-intensity monitoring program for this parameter. Samples identical to those required for routine monitoring purposes shall be taken on each of at least three operating days and analyzed. Results shall be expressed in terms of both concentration and mass, and shall be submitted no later than the end of the third month following the month when the action level was first exceeded. Results may be appended to the DMR or transmitted under separate cover to the addresses listed on the RECORDING, REPORTING AND MONITORING page of this permit. If levels higher than the actions levels are confirmed the permit may be reopened by the Department for consideration of revised action levels or effluent limits.

The permittee is not authorized to discharge any of listed parameters at levels which may cause or contribute to a violation of water quality standards.

Outfall Number & Effluent Parameter	Action Level	Units	Minimum Monitoring Requirements: Measurement Frequency	Sample Type
003, 004, 10A, 10C, 10D - (Oil/Water Separators)[4]				
Benzene	0.1	mg/l	Quarterly[3]	Grab
Toluene	0.1	mg/l	Quarterly[3]	Grab
Xylenes	0.1	mg/l	Quarterly[3]	Grab
Ethylbenzene	0.1	mg/l	Quarterly[3]	Grab
KP3 - KIAC Waste Heat-Steam & Generator Blowdown				
Chromium, Total	0.5	mg/l	Quqrterly	Grab
Copper, Total	0.5	mg/l	Quqrterly	Grab
Nickel, Total	0.5	mg/l	Quqrterly	Grab
KP4 - KIAC Cooling tower Blowdown				
Nickel, Total	0.5	mg/l	Quqrterly	Grab
KP5 - KIAC Cooling tower Blowdown				
Nickel, Total	0.5	mg/l	Quqrterly	Grab

[4] Quarterly sampling and outfall specific analysis and reported results for each of the listed Outfalls is required, (independent of the others listed).

SPDES No NY 000 8109

MODIFIED:

DEFINITIONS OF DAILY AVERAGE AND DAILY MAXIMUM

The daily average discharge is the total discharge by weight or in other appropriate units as specified herein, during a calendar month divided by the number of days in the month that the production or commercial facility was operating. Where less than daily sampling is required by this permit, the daily average discharge shall be determined by the summation of all the measured daily discharges in appropriate units as specified herein divided by the number of days during the calendar month when measurements were made.

The daily maximum discharge means the total discharge by weight or in other appropriate units as specified herein, during any calendar day.

MONITORING LOCATIONS

The permittee shall take samples and measurements, to comply with the monitoring requirements specified in this permit, at the location(s) indicated below: (Show sampling locations and outfalls with sketch or flow diagram as appropriate)

EXEMPTION (4) - DRAWINGS OF NON-PUBLIC AREAS

RECORDING, REPORTING AND ADDITIONAL MONITORING REQUIREMENTS

a) The permittee shall also refer to the General Conditions (Part II) of this permit for additional information concerning monitoring and reporting requirements and conditions.

b) The monitoring information required by this permit shall be summarized, signed and retained for a period of three years from the date of the sampling for subsequent inspection by the Department or its designated agent. Also;

[X] (if box is checked) monitoring information required by this permit shall be summarized and reported by submitting completed and signed Discharge Monitoring Report (DMR) forms for each 1 month reporting period to the locations specified below. Blank forms are available at the Department's Albany office listed below. The first reporting period begins on the effective date of this permit and the reports will be due no later than the 28th day of the month following the end of each reporting period.

Send the original (top sheet) of each DMR page to:

Department of Environmental Conservation
Division of Water
Bureau of Wastewater Facilities Operations
50 Wolf Road
Albany, New York 12233-3506

Phone: (518) 457-3790

Send the first copy (second sheet) of each DMR page to:

Department of Environmental Conservation
Regional Water Engineer
Region 2
One Hunters Point Plaza
47-40 21st Street
Long Island City, New York 11101-5407

c) A monthly "Wastewater Facility Operation Report..." (form 92-15-7) shall be submitted (if box is checked) to the [ ] Regional Water Engineer and/or [ ] County Health Department or Environmental Control Agency listed above.

d) Noncompliance with the provisions of this permit shall be reported to the Department as prescribed in the attached General Conditions (Part II).

e) Monitoring must be conducted according to test procedures approved under 40 CFR Part 136, unless other test procedures have been specified in this permit.

f) If the permittee monitors any pollutant more frequently than required by this permit, using test procedures approved under 40 CFR Part 136 or as specified in this permit, the results of this monitoring shall be included in the calculations and recording on the Discharge Monitoring Reports.

g) Calculations for all limitations which require averaging of measurements shall utilize an arithmetic mean unless otherwise specified in this permit.

h) Unless otherwise specified, all information recorded on the Discharge Monitoring Report shall be based upon measurements and sampling carried out during the most recently completed reporting period.

i) Any laboratory test or sample analysis required by this permit for which the State Commissioner of Health issues certificates of approval pursuant to section five hundred two of the Public Health Law shall be conducted by a laboratory which has been issued a certificate of approval. Inquiries regarding laboratory certification should be sent to the Environmental Laboratory Accreditation Program, New York State Health Department Center for Laboratories and Research, Division of Environmental Sciences, The Nelson A. Rockefeller State Plaza, Albany, New York 12201.

SPECIAL CONDITIONS - BEST MANAGEMENT PRACTICES

1. The permittee shall develop and implement a Best Management Practices (BMP) plan to prevent, or minimize the potential for, release of significant amounts of toxic or hazardous pollutants to the waters of the State through plant site runoff; spillage and leaks; sludge or waste disposal; or drainage from raw material storage.

2. The permittee shall review all facility components or systems (including material storage areas; in-plant transfer, process and material handling areas; loading and unloading operations; and sludge and waste disposal areas) where toxic or hazardous pollutants are used, manufactured, stored or handled to evaluate the potential for the release of significant amounts of such pollutants to the waters of the State. In performing such an evaluation, the permittee shall consider such factors as the probability of equipment failure or improper operation, settlement of facility air emissions, the effects of natural phenomena such as freezing temperatures and precipitation, fires, and the facility's history of spills and leaks. For hazardous pollutants, the list of reportable quantities as defined in 40 CFR, Part 117 may be used as a guide in determining significant amounts of releases. For toxic pollutants, the relative toxicity of the pollutant shall be considered in determining the significance of potential releases.

   The review shall address all substances present at the facility that are listed as toxic pollutants under Section 307(a)(1) of the Clean Water Act or as hazardous pollutants under Section 311 of the Act or that are identified as Chemicals of Concern by the Industrial Chemical Survey.

3. Whenever the potential for a significant release of toxic or hazardous pollutants to State waters is determined to be present, the permittee shall identify Best Management Practices that have been established to minimize such potential releases. Where BMPs are inadequate or absent, appropriate BMPs shall be established. In selecting appropriate BMPs, the permittee shall consider typical industry practices such as spill reporting procedures, risk identification and assessment, employee training, inspections and records, preventive maintenance, good housekeeping, materials compatibility and security. In addition, the permittee may consider structural measures (such as secondary containment devices) where appropriate.

4. Development of the BMP plan shall include sampling of waste stream segments for the purpose of toxic "hot spot" [5] identification. The economic achievability of technology-based end-of-pipe treatment will not be considered until plant site "hot spot" sources have been identified, contained, removed or minimized through the imposition of site specific BMPs or application of internal facility treatment technology.

5. The BMP plan shall be documented in narrative form and shall include any necessary plot plans, drawings or maps. Other documents already prepared for the facility such as a Safety Manual or a Spill Prevention, Control and Countermeasure (SPCC) plan may be used as part of the plan and may be incorporated by reference. A copy of the BMP plan shall be maintained at the facility and shall be available to authorized Department representatives upon request. As a minimum, the plan shall include the following BMP's:

   a. BMP Committee
   b. Reporting of BMP Incidents
   c. Risk Identification and Assessment
   d. Employee Training
   e. Inspections and Records
   f. Preventive Maintenance
   g. Good Housekeeping
   h. Materials Compatibility
   i. Security

6. The BMP plan shall be modified whenever changes at the facility materially increase the potential for significant releases of toxic or hazardous pollutants or where actual releases indicate the plan is inadequate.

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[5] A "hot spot" is a segment of an industrial facility; including but not limited to soil, equipment, material storage areas, sewer lines etc; which contributes elevated levels of problem pollutants to the wastewater and/or storm water collection system of that facility. For the purposes of this definition, problem pollutants are substances for which end of pipe treatment to meet a water quality or technology requirement may, considering the results of wastestream segment sampling, be deemed unreasonable. For the purposes of this definition, an elevated level is a concentration or mass loading of the pollutant in question which is adequately higher than the end of pipe concentration of that same pollutant so as to allow for an economically justify removal and/or isolation of the segment and/or B.A.T. treatment of wastewaters emanating from the segment.

SCHEDULE OF COMPLIANCE

a) The permittee shall comply with the following schedule.

Action Code	Outfall Number(s)	Compliance Action	Due Date
	Outfalls including storm sewers	Revise Airport Rules and Regulations, specifically the Operations section, to include Best Management Practices (BMP) for the minimization of the discharge of ethylene glycol to surface and/or groundwaters.	Jan. 1, 1988
		Implement BMP for the minimization of the discharge of ethylene glycol to surface and/or groundwaters.	Jan. 1, 1988

b) The permittee shall submit a written notice of compliance or non-compliance with each of the above schedule dates no later than 14 days following each elapsed date, unless conditions require more immediate notice under terms of the General Conditions (Part II), Section 5. All such compliance or non-compliance notification shall be sent to the locations listed under the section of this permit entitled RECORDING, REPORTING AND ADDITIONAL MONITORING REQUIREMENTS. Each notice of non-compliance shall include the following information:

1. A short description of the non-compliance;
2. A description of any actions taken or proposed by the permittee to comply with the elapsed schedule requirements without further delay and to limit environmental impact associated with the non-compliance;
3. A description or any factors which tend to explain or mitigate the non-compliance; and
4. An estimate of the date the permittee will comply with the elapsed schedule requirement and an assessment of the probability that the permittee will meet the next scheduled requirement on time.

c) The permittee shall submit copies of any document required by the above schedule of compliance to NYSDEC Regional Water Engineer at the location listed under the section of this permit entitled RECORDING, REPORTING AND ADDITIONAL MONITORING REQUIREMENTS, unless otherwise specified in this permit or in writing by the Department.

APPENDIX 4

Evaluation of the Potential for Soil Vapor Intrusion at Terminal 5

THE PORT AUTHORITY OF NY & NJ

John F. Kennedy International Airport

TERMINAL 5 EXPANSION REMEDIAL ACTION WORK PLAN

APPENDIX 4

Evaluation of the Potential for Soil Vapor Intrusion

Port Authority of New York & New Jersey

August 2005
4907011

Prepared by:
MALCOLM PIRNIE, INC.
17-17 Route 208 North
Fair Lawn, NJ 07410

MALCOLM PIRNIE

Evaluation of the Potential for Soil Vapor Intrusion at Terminal 5
JFK International Airport
August 2005

1.0 Introduction

The potential for volatile chemicals in subsurface soil and/or groundwater to be transported though pore spaces in the unsaturated soil zone as chemical vapors and infiltrate and affect the indoor air of overlying buildings, and thus represent a source of exposure to building occupants, is a current and growing concern of the regulatory community.

When chemical vapors are present in the zone next to or under the foundation of a building, vapor intrusion is possible. Soil vapor can enter a building through cracks or perforations in foundation slabs or basement floors and walls, and through openings around sump pumps or where pipes and electrical wires go through the foundation, primarily due to a difference in internal and external air pressures. Earlier this year, the New York State Department of Health (NYSDOH) issued draft guidance for evaluating soil vapor intrusion in the State of New York (NYSDOH, 2005).

A concern for potential soil vapor intrusion into the planned jetBlue Airways Terminal 5 (Terminal 5) building at JFK International Airport has been expressed by the New York State Department of Environmental Conservation (NYSDEC) because of subsurface conditions at the Terminal 5 site.

Factors that can affect soil vapor intrusion generally fall into two categories (NYSDOH, 2005):

- Environmental factors, including source location; soil conditions; volatile chemical concentrations; weather conditions; and biodegradation processes, and
- Building factors, including foundation type and integrity; subsurface features; operation of heating, ventilating and air conditioning (HVAC) systems and mechanical equipment; and air exchange rates.

There are a number of sources of volatile chemicals in indoor air that can originate from other than subsurface sources, including outdoor air; off-gassing from building materials and furnishings; cleaning and maintenance products; occupant emissions; and indoor emissions (NYSDOH, 2005).

The NYSDOH (2005) notes that all information known about a site should be considered (i.e., taking a "whole picture" approach) in evaluating the potential for soil vapor intrusion and determining what actions, if any, may be necessary to prevent future human exposures. This information could include, but is not limited to, the following:

- The nature and extent of subsurface contamination in all environmental media;

customers on 248 flights, and an additional 20% for well wishers and greeters on a daily basis. The peak Terminal 5 building simultaneous occupancy is assumed to be 7,000 people.

The Arrivals Level, including the baggage claim area, also known as the Central Processor Floor, will be located on the ground floor. It will be constructed on 10-inch thick concrete foundation slabs, at two elevations. Some areas will be constructed at grade (i.e., at 11.17 feet elevation) while other areas will be constructed at 8.5 feet elevation, as indicated on Figure 1. The foundation slabs, which will be primarily slab-on-grade supported internally by single piles at areas where there are no columns and hefty piles at column locations, will be constructed over a 6-inch sub-base of crushed stone or crushed concrete. An engineered fill layer under the sub-base is not anticipated (Personal communication with Gensler). A vapor barrier cover will be installed over the sub-base below the slabs, where indicated in the construction specifications. The vapor barrier, which will be resistant to deterioration in accordance with ASTM E 154, will be constructed of polyethylene sheeting no less than 10 mils thick, with a smooth surface (Personal communication with Gensler).

Enclosed outbound baggage makeup and inbound baggage stripping areas will be located on the airside of the Arrivals Level, but will have overhead doors that are expected to be open about 90% of the time to allow easy entry and exit by baggage tugs. Noted on Figure 1 as "open" areas, these areas were not evaluated further as enclosed spaces.

The Departures Level will be located on the second floor at 27.17 feet elevation at the gates and 30.17 feet elevation at the ticket hall. The Departures Level roadway will function as an integral part of the building structure; in addition to departures, the structure will function as the roof of the baggage claim hall below.

Fresh air intakes will be located at or above the Terminal 5 building roof line to minimize the quantities of external air pollutants drawn into the building's air handling units (AHUs). The bottom of the outdoor air intake louvers for the AHUs on the roof will be at least 4 feet above the roof level. The top of the louvers will be no greater than 13 feet above the roof. A minimum separation distance of 25 feet will be maintained between ventilation intake and contaminated exhaust points. A minimum separation distance of 10 feet will be maintained between ventilation intake and AHU exhaust points. The proposed design strategy is to include particulate filters in all air handling systems and to provide space in the air handling systems serving the East Concourse (AHUs 1-6) to allow the installation of gas phase filters, as needed, in the future. For the remaining AHUs, there is the option of replacing the particulate filters with gas phase filters in the future.

The mechanical system for the Terminal 5 building is designed to maintain positive pressure in the large open spaces of the building to minimize the infiltration of unconditioned outside air. A positive pressure differential of about 400 Pascals (Pa) will be maintained (Personal communication with ARUP). Outside air will be supplied to the continuously occupied areas in accordance with ASHRAE Standard 62-1999 and

standard industry practice. For example, on the Arrivals Level, the volume of outside air introduced to the Baggage Claim Hall is based on the need to maintain adequate ventilation for occupants and the need to maintain positive pressure. These two needs will be satisfied by the use of carbon dioxide sensors and supply/return fan tracking such that adequate outside air is supplied and the supply volume is always greater than the return volume. Space pressure sensors are also used in some locations as a further level of control. However, in those locations served by a variable air volume (VAV) mechanical system, there is no accurate control of return air volumes with respect to supply air volumes (Personal communication with ARUP).

3.0 Air Emission and Ambient Air Quality

Generally, indoor air quality in airport terminal buildings reflects a combination of:

- Ambient air quality outside the buildings;
- Emissions in the building, such as from carpets or fabrics, paints, or other vapors associated with new construction (glues, tile mastic, etc.); cleaning and maintenance products; and indoor operations (stoves for food concessions); and, perhaps,
- Intrusion into the building of chemical vapors from underlying soils and/or groundwater contaminated by underground storage tanks, former fuel pumping pits, and other related sources.

The major sources of air pollution at airport terminal buildings are airside and landside vehicles using fossil fuels. On the airside, these typically include aircraft; auxiliary power units (APU); and ground support equipment (GSE) for baggage-handling, maintenance/repair, refueling, food service, and other support operations. On the landside, these could include private automobiles, taxis, for-hire vehicles, shuttles/buses, trucks, and trains that transport people and goods.

A report prepared by the Northeast States for Coordinated Air Use Management and Center for Clean Air Policy (NESCAUM and CCAP, 2003) presents the results of emissions inventories for several airports in the northeast U.S. including Logan Airport in Boston, MA, the most similar to JFK International Airport. Table 1 presents the 1999 emissions inventory for Logan Airport for hydrocarbon, nitrous oxide (NOx), and hazardous air pollutant emissions from aircraft and GSE. In 1999, Logan Airport had 251,083 landings and takeoffs (LTOs). Crude estimates of aircraft emissions at Terminal 5 were made and included in Table 1 based on the 1999 emissions inventory for landings and takeoffs (LTOs) at the Logan Airport and the ratio of the design LTOs for Terminal 5 (181,040 LTOs/year) (*JFK International Airport Terminal 5 Redevelopment, Basis of Design,* February 1st 2005) and the 1999 LTOs at Logan Airport (251,083).

As indicated in Table 1, major sources of hydrocarbon emissions include both aircraft and GSE. For NOx, aircraft are the primary source of emissions with GSE contributing

an order of magnitude less. Among the hazardous air pollutants, benzene, toluene, ethylbenzene, and xylenes (BTEX) and the polycyclic aromatic hydrocarbons (PAHs) are constituents in jet fuels that are typically detected in subsurface soil and groundwater underlying and in the immediate vicinity of airport terminal buildings, where underground fuel line and hydrant pits have resulted in environmental contamination. As indicated in Table 1, the emissions rates of these pollutants from aircraft and GSE are on the order of tons/year.

4.0 Subsurface Soil and Groundwater Conditions at Terminal 5

The former fuel pumping pits at Terminal 5 pumped Commercial Jet A fuel. The free product remaining in the soil is a weathered Jet A fuel. The primary constituent of Jet A fuel is kerosene (98%; comprised of C-7 through C-18 hydrocarbons) with <1% benzene and various additives. Additives may include antioxidants, metal deactivators, static dissipators, and fuel system icing inhibitors. It should also be noted that weathered fuel typically does not contain the same constituents as fresh fuel.

This evaluation is based on residual volatile and semi-volatile organic compounds (VOCs and SVOCs, respectively) detected in groundwater and subsurface soil underling the footprint of the Terminal 5 building and within 100 feet horizontally of the Terminal 5 building footprint, as presented in Tables 2 and 3.

5.0 Subsurface Vapor Intrusion Modeling Analysis

The NYSDOH (2005) indicates that soil vapor intrusion modeling may be used in the evaluation process, particularly to estimate potential exposures when field samples cannot be collected (e.g., where buildings have not yet been constructed over the subsurface contamination). If a model is used, the NYSDOH (2005) notes that it should incorporate site-specific parameters as much as possible and that both the limitations of the model and the sensitivity of the variables in the model should be understood and discussed with the modeling results.

Johnson and Ettinger (J&E) (1991) introduced a screening-level model that incorporates both convective and diffusive mechanisms for estimating the transport of chemical vapors from either subsurface soil or groundwater into indoor spaces located directly above the source of contamination. The J&E model is a one-dimensional analytical solution to convective and diffusive vapor transport into indoor spaces and provides an estimated attenuation coefficient that relates the vapor concentration in the indoor space to the vapor concentration at the source of contamination (USEPA, 2004). Inputs to the model include chemical properties of the chemicals, saturated and unsaturated zone soil properties, and structural properties of the building. The model can be run to predict indoor air concentrations and potential health risk or to predict subsurface soil or groundwater concentrations that should not result in prescribed target risk levels being exceeded. The J&E model, which is currently the model of choice for evaluating subsurface vapor intrusion into indoor air (see, for example, USEPA, 2002, PADEP,

2005), was used in this evaluation to predict protective subsurface soil and groundwater concentrations.

The USEPA *User's Guide for Evaluating Subsurface Vapor Intrusion into Buildings* (USEPA, 2004) and computerized version of the J&E model were used to model the potential vapor intrusion in the Arrivals Level of Terminal 5. Detailed explanations of the methodology and equations used in the model are provided in the USEPA User's Guide. The advanced groundwater and soil models were used since, among their features, they allow the input of up to three soil strata.

Since some areas of the Arrivals Level will be constructed at 11.17 feet elevation and other areas of the Arrivals Level will be constructed at 8.5 feet elevation, separate J&E modeling analyses were run for representative areas at each elevation. The subsurface conceptual model used to direct the groundwater and subsurface soil modeling is presented in Figure 2.

Table 4 presents the approximate square footage estimates for various areas on the Arrivals Level. These estimates were determined by dividing the floor plan for the Arrivals Level into a series of elementary figures, including three rectangles, two triangles, and the area between two arcs. The elevation of each figure was constant except for the triangles where the approximate area with each elevation was estimated. The ceiling heights were estimated from the differences in elevation (i.e., from top-of-slab to top-of-slab) of the Arrivals Level and Departures Level corrected for the thickness of the Departure Level slab. Note that the elevation of the Departures Level floor in the gate area (27.17 feet) is 3 feet less than in the main terminal area (30.17 feet). The enclosed areas of the Arrivals Level at 11.7 feet elevation were estimated at approximately 173,960 square feet (or 52% of the total floor area) while the enclosed areas of the Arrivals Level at 8.5 feet elevation were estimated at approximately 97, 940 square feet (or about 29% of the total floor area). The "open" areas of the Arrivals Level were estimated at approximately 62,565 square feet (or 19% of the total floor area).

As indicated on Figure 2, the area designated "Area E" was used to represent the 11.17 feet elevation areas and the area designated "Area C2" was used to represent the 8.5 feet elevation areas.

Outdoor air volumes and floor areas for selected AHUs for the Arrivals Level of the Terminal 5 building (ARUP, personal communication) are presented in Table 5. Based on these data, approximate air exchange rates were estimated for ceiling heights of 19 and 21 feet. As indicated in Table 5, for a 19-foot ceiling, air exchange rates range from 0.58/hour to 6.33/hour, with an average of 1.35/hour. As also indicated in Table 5, for a 21-foot ceiling, air exchange rates range from 0.64/hour to 7/hour, with an average of 1.49/hour. Since the areas serviced by these AHUs do not match the representative areas developed for this modeling analysis, as described above, an air exchange rate of 1/hour was used in the J&E modeling analyses, recognizing that the actual air exchange rates, which will vary based on carbon dioxide levels, may be higher or lower.

Although the sub-base under the foundations will be 6 inches of crushed stone or crushed concrete, the sub-base was characterized as sand in the models since it is the most permeable of the default soil types in the model; the permeability to vapor flow of crushed stone or crushed concrete may be greater than that of sand. The hydraulic fill layer below the sub-base is predominantly sand with varying amounts of silt and gravel. From standard penetration tests, the upper material is generally dense while the lower few feet is generally loose.

An indoor airport terminal worker was selected as the potentially exposed receptor of concern since the frequency and duration of exposure would be greater for these workers than for airline customers or visitors.

Geotechnical, building, and exposure parameter values, and target risk levels, input to the J&E groundwater and soil modeling analyses, for the two Arrivals Level elevations, are presented in Table 6. Site-specific parameter values were used to extent possible, as indicated in Table 6. For other parameters, default values provided in the USEPA's computerized version of the J&E model were used. The "Data Entry Sheet" and "Results Sheet" from the J&E model for a representative chemical in groundwater (toluene) and subsurface soil (methylene chloride), for each representative area of the Terminal 5 building, are attached. The site-specific and default parameter values are presented on the "Data Entry Sheet".

The predicted groundwater and subsurface soil concentrations, protective of prescribed target risk levels are presented on the "Results Sheet" and summarized in Tables 2 and 3 for the representative 11.17 feet elevation (Area E) and 8.5 feet elevation (Area C2) areas, respectively.

For many of the chemicals in groundwater and/or subsurface soil, the J&E model output indicates that the potential for vapor intrusion is not of concern (NOC). For groundwater, this is because the risk-based screening level predicted by the J&E model is at or above the maximum concentration of the chemical that can be dissolved in the water (i.e., the water solubility limit of the chemical). For soil, this is because the risk-based screening level predicted by the J&E model is at or above the concentration of the chemical at which all soil pore space (both air-filled and water-filled) is saturated with the chemical and the adsorptive limits of the soil particles can be reached(i.e., the soil saturation limit of the chemical or C_{sat}). For the other chemicals, the risk-based screening levels (i.e., the predicted groundwater or soil concentrations) are considerably higher than the detected concentrations, also indicating that the potential for vapor intrusion is not of concern. Two exceptions are noted for soil at MW-19 which is located within 100 feet of the Terminal 5 footprint: the ethylbenzene concentration, which may represent free product since it is higher than C_{sat}, and the xylenes concentration.

The sensitivity of the J&E modeling analysis to the following three site-specific parameter values was also evaluated:

- Soil-building pressure differential. The default value of 40 g/cm-s^2 (or 4 Pa) in the J&E model was used to derive the risk-based screening levels, assuming that the building is under negative pressure (i.e., that the pressure in the underlying and surrounding soil is greater than that in the building). This assumption and pressure differential are very conservative since positive pressure (of about 400 Pa) will be maintained in the Terminal 5 building. Therefore, less negative pressure differentials of 10 g/cm-s^2 and 1 g/cm-s^2 were also evaluated.

- Indoor air exchange rate. A site-specific average value of 1/hour was used to derive the risk-based screening levels. However, since these exchange rates will vary throughout the Terminal 5 building, as indicated in Table 5, the lowest (0.58/hour) and highest (1.2/hour) exchange rates were evaluated. The higher exchange rates associated with air handling units 18, 19, and 26 were not evaluated; their consideration would result in higher risk-based screening levels.

- Enclosed space height. Site-specific heights of approximately 19 feet (579.1 cm) and 21 feet (640.1 cm) were used to derive the risk-based screening levels. However, since 8-foot (243.7-cm) ceilings will be installed in some areas, this height was evaluated.

The sensitivity analysis, which involved various combinations of these three parameters, was conducted for naphthalene in groundwater and methylene chloride in soil. The results of this sensitivity analysis are presented in Table 7. As indicated in Table 7, the predicted risk-based screening levels are either not of concern (NOC) or well above the detected concentrations in groundwater or soil.

There is some uncertainty, as well, with the risk-based screening levels, particularly due to the following parameters in the J&E modeling analysis.

- Sub-base material. While the sub-base will be crushed stone or crushed concrete, the predicted risk-based screening levels are based on the assumption that this material will be sand – the most permeable of the standard soil types included in the J&E model. A more permeable sub-base could lower the risk-based screening levels. Regardless, as noted above, the Terminal 5 building will have a sub-slab vapor barrier and be maintained at positive pressure to prevent or mitigate the potential for vapor intrusion.

- Geotechnical parameters. While site-specific values for total porosity, soil water-filled porosity, and soil organic carbon fraction are unavailable, the risk-based screening levels are based on the default values included in the J&E model. The actual parameter values could increase or decrease the risk-based screening levels.

However, since the predicted risk-based screening levels, and even the less conservative predicted risk-based screening levels from the sensitivity analysis, are much greater than the detected chemical concentrations in groundwater and soil, these uncertainties are not an issue to this evaluation.

The source vapor concentrations (in ug/$m^{3)}$ and average vapor flow rates into the Terminal 5 building areas (in cm^3/s) estimated by the J&E model runs described above (see the attached "Intermediate Calculations Sheet") were used to approximate emissions rates of representative chemicals in groundwater (toluene) and soil (methylene chloride) under the modeled conditions. Emissions rates for toluene in groundwater were about 0.006 pounds/year (or 3E-06 tons/year) and 0.002 pounds/year (or 1E-06 tons/year) for the 11.17 feet and 8.5 feet elevation areas, respectively. Emissions rate for methylene chloride in soil were about 0.04 pounds/year (or 2E-05 tons/year) and 0.012 pounds/year (or 6E-06 tons/year) for the 11.17 feet and 8.5 feet elevation areas, respectively. These estimated emissions rates are orders of magnitude lower than those from airside and landside emissions to the ambient air, as presented in Table 1 and discussed above, and indicate that the airside and landside emissions may be of greater importance to indoor air quality in the Terminal 5 building than subsurface vapors.

6.0 Fate of Petroleum Hydrocarbons in the Subsurface Environment

Commercial jet fuel is classified as Jet Fuel A or Jet Fuel A-1. Both of these fuels are petroleum distillates blended from kerosene fractions and used in the U.S. in civilian aviation for commercial turboprop and turbojet aircraft. Jet Fuel A-1 has a lower freezing point than Jet Fuel A. Jet Fuel A contains less than 0.1% benzene by volume (USCG, 2005). This is confirmed by Chevron Phillips CHEM which lists the aromatic hydrocarbons in Jet Fuel A as: benzene <0.8% by weight; toluene <1% by weight; total xylenes < 5.4% by weight; and trimethylbenzene <6.2% by weight (CPCHEM, 2001).

It has been reported that, following spills, the relatively lighter, more volatile, mobile and water soluble constituents in Jet fuel A will tend to fairly quickly evaporate into the atmosphere or migrate to groundwater. Benzenes, toluene, and xylenes have mid-range octanol-water partition coefficients and high volatility. When exposed to oxygen and sunlight, most of these compounds tend to break down rather quickly (Irwin et al., 1997). However in groundwater many of these compounds tend to be more persistent than in surface water and readily partition on an equilibrium basis back and forth between water and solid (soil and sediment) media. In a study of the biodegradation of the water soluble fraction of Jet A fuel, it was determined that the higher molecular weight polycyclic aromatic hydrocarbons (PAHs) tended to be the last to degrade (Irwin et al., 1997).

Biodegradation of the BTEX constituents in vadose zone soils has been the subject of studies primarily conducted at gasoline spill sites. Most of these studies consider aerobic biodegradation and its dependence on factors such as the moisture content of the soils and oxygen replenishment. Near the water table, aerobic biodegradation and volatilization are the principal mechanisms for removal. While there may be considerable variation, the biodegradation half-lives for the BTEX constituents rang from a fraction of an hour to hundreds of hours. Biodegradation of the BTEX constituents is an important fate process at many sites and predictive models not accounting for biodegradation could overestimate the risks from upwards vapor fluxes by 10 to 10,000 times at some sites (Roggemans et al., 2001).

Aerobic biodegradation is dependent on oxygen replenishment which is a function of the diffusivity and permeability of near surface soils and the subsurface building structure and gradients driving the processes. In this regard, a slab or building will tend to promote long-term drying of the underlying soil which could, in-turn, reduce biodegradation rates. Studies indicate that biodegradation rates are significantly reduced in low moisture content soils, with BTEX concentrations in open soil areas as much as two orders of magnitude lower than in an adjacent building slab area (Hers et al., 2000).

7.0 Summary and Conclusions

This evaluation provides a weight of evidence approach to conclude that the potential for soil vapor intrusion into the Terminal 5 building is not a concern. The following information provides the weight of evidence to reach this conclusion:

- Outdoor and indoor emissions sources of hazardous air pollutants should far outweigh soil vapor as potential contributors to indoor air quality in the Terminal 5 building. As noted above, however, indoor air quality will be controlled through the design and operation of the AHUs.

- The Terminal 5 building is designed to include a sub-slab vapor barrier and to maintain positive air pressure (of about 400 Pa) within the building. In this regard, the NYSDOH (2005) indicates that HVAC system modification – "a technique where the building's HVAC system is modified to avoid depressurization of the building relative to the underlying and surrounding soil (i.e., to maintain a positive pressure within the building" – is a method of mitigating vapor intrusion. These design features, therefore, should eliminate the potential, if any, for soil vapor intrusion into the building.

- With the exception of methylene chloride in subsurface soil (a likely laboratory contaminant), chlorinated hydrocarbons were not detected in groundwater or subsurface soil underlying or within 100 feet horizontally of the Terminal 5 building footprint. Petroleum hydrocarbons, which were the predominant detected chemicals, are generally less toxic and more amenable to biodegradation in the environment.

- The J&E modeling analyses indicates that chemical concentrations in groundwater and subsurface soil underlying or within 100 feet horizontally of the Terminal 5 building footprint are low enough to not pose a vapor intrusion hazard. For many of the chemicals, the modeling analyses indicated "not of concern", meaning that the predicted groundwater or subsurface soil concentrations protective of the prescribed target risk levels would be greater than their water solubility limit or soil saturation concentration. For the other chemicals, the predicted groundwater or subsurface soil concentrations protective of the prescribed target risk levels are orders of magnitude greater than detected concentrations in those environmental media.

8.0 References

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FIGURES

EXEMPTION (4) – DRAWINGS OF NON-PUBLIC AREAS

TABLES

Table 1
1999 Logan Airport and Projected Terminal 5 Emissions Inventory

Pollutant	1999 Logan Airport		Projected Terminal 5
	Aircraft (tons/year)	Ground Support Equipment (GSE) (tons/year)	Aircraft (tons/year)
Hydrocarbons	562	293	405
NOx	2664	233	1918
1,3-Butadine	10.7	Not provided	7.7
Benzene	15.7	Not provided	11.3
Formaldehyde	82.1	Not provided	59.1
Acetaldehyde	25.3	Not provided	18.2
Acrolein	11.1	Not provided	8
Polycyclic Organic Matter as 16 PAHs[(1)]	0.061	Not provided	0.044
Polycyclic Organic Matter as 7 PAHs[(1)]	0.0017	Not provided	0.0012
Styrene	2.5	Not provided	1.8
Ethylbenzene	3.1	Not provided	2.2
n-Hexane	1.0	Not provided	0.72
Propinaldehyde	5.1	Not provided	3.7
Toluene	18.1	Not provided	12
Xylenes	11.2	Not provided	8.1
Lead	0.18	Not provided	0.13

Notes:
(1) The seven polycyclic aromatic hydrocarbons (PAHs) are benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, chrysene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene. The 16 PAH compounds include acenaphthene, acenaphthylene, anthracene, benzo(g,h,i)perylene, fluoranthene, fluorene, naphthalene, phenanthrene, and pyrene in addition to the previous seven.

Table 2
Risk-Based Screening Summary: Terminal 5, Area E, 11.17 Elevation

Chemical	CAS #	USEPA Screen[1]		Risk-Based Screening-Level[2]		Data within Terminal 5 Footprint[3]			Data within 100' of Terminal 5 Footprint[4]		
		Sufficiently Toxic?	Sufficiently Volatile?		Basis	Frequency of Detection	Detected Concentration Range	Location of Maximum	Frequency of Detection	Detected Concentration Range	Location of Maximum
Groundwater (ug/L)											
Benzene	71432	Yes	Yes	150	10^{-6} Risk	0/7	--	--	3/4	10.2 - 38.6	MW-19
Ethylbenzene	100414	Yes	Yes	NOC[5]	--	2/7	0.380 - 1.60	MW-26	3/4	0.403 - 169	MW-19
Methyl-tert-butyl ether	1634044	Yes	Yes	8,340,000	HQ = 1	5/7	0.434 - 4.50	MW-24	4/4	0.629 - 33.4	MW-20
tert-Butyl alcohol	75650	--	--	--	--	0/7	--	--	1/4	8.95	MW-22
Toluene	108883	Yes	Yes	155,000	HQ = 1	1/7	1.87	MW-4	0/4	--	--
Xylenes	1330207	Yes	Yes	39,600[6]	HQ =1	0/7	--	--	2/4	8.71 - 104	MW-19
2-Methylnaphthalene	91576	Yes	Yes	NOC	--	3/7	0.298 - 9.75	MW-9	3/4	28.7 - 88.1	MW-20
4-Methylphenol	106455	Yes	No	--	--	3/7	19.2 - 57.6	MW-8	0/4	--	--
Acenaphthene	83329	Yes	Yes	NOC	--	4/7	0.674 - 3.87	MW-26	3/4	0.462 - 12.9	MW-27
Acenaphthylene	208968	--	Yes	--	--	2/7	0.204 - 0.310	MW-24	0/4	--	--
Anthracene	120127	No	Yes	--	--	1/7	1	MW-26	0/4	--	--
Dibenzofuran	132649	Yes	Yes	NOC	--	1/7	0.324	MW-9	0/4	--	--
Fluoranthene	206440	No	Yes	NOC	--	1/7	0.354	MW-26	1/4	0.293	MW-27
Fluorene	86737	Yes	Yes	NOC	--	2/7	0.388 - 2.10	MW-26	0/4	--	--
Naphthalene	91203	Yes	Yes	19,400	HQ = 1	4/7	0.235 - 22.7	MW-9	3/4	5.56 - 213	MW-20
Phenanthrene	85018	--	Yes	--	--	1/7	2.9	MW-26	2/4	0.150 - 0.344	MW-19
Pyrene	129000	Yes	Yes	NOC	--	1/7	0.59	MW-26	0/4	--	--
Soil (ug/kg)											
Ethylbenzene	100414	Yes	Yes	13,500	C_{sat}	0/7	--	--	2/4	15.7 - 25,800	MW-19
Xylenes	1330207	Yes	Yes	15,600[6]	HQ = 1	0/7	--	--	1/4	15,200	MW-19
2-Methylnaphthalene	91576	Yes	Yes	NOC	--	2/7	160 -190	MW-26	2/4	172 - 12,100	MW-20
bis(2-Ethylhexyl)phthalate	117817	No	No	--	--	1/7	87 J	MW-2	1/4	64.5	MW-27
Chrysene	218019	Yes	Yes	NOC	--	0/7	--	--	1/4	164	MW-22
Methylene chloride	75092	Yes	Yes	225	10^{-6} Risk	1/7	8.9 B	MW-9	0/4	--	--
Dibenzofuran	132649	Yes	Yes	NOC	--	0/7	--	--	1/4	280	MW-20
Fluoranthene	206440	No	Yes	--	--	0/7	--	--	1/4	119	MW-20
Fluorene	86737	Yes	Yes	NOC	--	0/7	--	--	1/4	243	MW-20
Naphthalene	91203	Yes	Yes	46,000	HQ = 1	0/7	--	--	2/4	87 - 5,540	MW-20
Phenanthrene	85018			--	--	0/7	--	--	1/4	141	MW-20
Pyrene	129000	Yes	Yes	NOC	--	0/7	--	--	1/4	84	MW-20

Notes:
(1) = Per Table 1 of USEPA. 2004. *User's Guide for Evaluating Subsurface Vapor Intrusion into Buildings. Office of Emergency and Remedial Response*, Washington, DC. (February 2004)
(2) = Derived using the USEPA version of the Johnson and Ettinger (1991) Model for Subsurface Vapor Intrusion into Buildings accessed at:
www.epa.gov/oswer/riskassessment/airmodel/johnson_ettinger.htm
For groundwater, *GW-ADV Version 3.1 02/04. For soil, SL-ADV Version 3.1 02/04*
Target risk for noncarcinogenic health effects is a hazard quotient (HQ) = 1. Target incremental lifetime cancer risk = 10^{-6} risk. C_{sat} = soil saturation concentration
(3) = Data for MWs 2, 4, 8, 9, 24, 25, 26
(4) = Data for MWs 19, 20, 22, 27
(5) = Not of concern = the groundwater concentration at or above the solubility limit or the soil concentration at or above the soil saturation limit is not of concern for this pathway
(6) = Based on p-xylene

Table 3
Risk-Based Screening Summary: Terminal 5, Area C2, 8.5 Elevation

Chemical	CAS #	USEPA Screen[1]		Risk-Based Screening-Level[2]		Data within Terminal 5 Footprint[3]			Data within 100' of Terminal 5 Footprint[4]		
		Sufficiently Toxic?	Sufficiently Volatile?		Basis	Frequency of Detection	Detected Concentration Range	Location of Maximum	Frequency of Detection	Detected Concentration Range	Location of Maximum
Groundwater (ug/L)											
Benzene	71432	Yes	Yes	105	10^{-6} Risk	0/7	--	--	3/4	10.2 - 38.6	MW-19
Ethylbenzene	100414	Yes	Yes	NOC[5]	--	2/7	0.380 - 1.60	MW-26	3/4	0.403 - 169	MW-19
Methyl-tert-butyl ether	1634044	Yes	Yes	5,350,000	HQ = 1	5/7	0.434 - 4.50	MW-24	4/4	0.629 - 33.4	MW-20
tert-Butyl alcohol	75650	--	--	--	--	0/7	--	--	1/4	8.95	MW-22
Toluene	108883	Yes	Yes	109,000	HQ = 1	1/7	1.87	MW-4	0/4	--	--
Xylenes	1330207	Yes	Yes	28,400[6]	HQ = 1	0/7	--	--	2/4	8.71 - 104	MW-19
2-Methylnaphthalene	91576	Yes	Yes	NOC	--	3/7	0.298 - 9.75	MW-9	3/4	28.7 - 88.1	MW-20
4-Methylphenol	106455	Yes	No	--	--	3/7	19.2 - 57.6	MW-8	0/4	--	--
Acenaphthene	83329	Yes	Yes	NOC	--	4/7	0.674 - 3.87	MW-26	3/4	0.462 - 12.9	MW-27
Acenaphthylene	208968	--	Yes	--	--	2/7	0.204 - 0.310	MW-24	0/4	--	--
Anthracene	120127	No	Yes	--	--	1/7	1	MW-26	0/4	--	--
Dibenzofuran	132649	Yes	Yes	NOC	--	1/7	0.324	MW-9	0/4	--	--
Fluoranthene	206440	No	Yes	--	--	1/7	0.354	MW-26	1/4	0.293	MW-27
Fluorene	86737	Yes	Yes	NOC	--	2/7	0.388 - 2.10	MW-26	0/4	--	--
Naphthalene	91203	Yes	Yes	12,500	HQ = 1	4/7	0.235 - 22.7	MW-9	3/4	5.56 - 213	MW-20
Phenanthrene	85018	--	Yes	--	--	1/7	2.9	MW-26	2/4	0.150 - 0.344	MW-19
Pyrene	129000	Yes	Yes	NOC	--	1/7	0.59	MW-26	0/4	--	--
Soil (ug/kg)											
Ethylbenzene	100414	Yes	Yes	59,700	HQ = 1	0/7	--	--	2/4	15.7 - 25,800	MW-19
Xylenes	1330207	Yes	Yes	6,600	HQ = 1	0/7	--	--	1/4	15,200	MW-19
2-Methylnaphthalene	91576	Yes	Yes	NOC	--	2/7	160 -190	MW-26	2/4	172 - 12,100	MW-20
bis(2-Ethylhexyl)phthalate	117817	No	No	--	--	1/7	87 J	MW-2	1/4	64.5	MW-27
Chrysene	218019	Yes	Yes	NOC	--	0/7	--	--	1/4	164	MW-22
Methylene chloride	75092	Yes	Yes	80	10^{-6} Risk	1/7	8.9 B	MW-9	0/4	--	--
Dibenzofuran	132649	Yes	Yes	NOC	--	0/7	--	--	1/4	280	MW-20
Fluoranthene	206440	No	Yes	--	--	0/7	--	--	1/4	119	MW-20
Fluorene	86737	Yes	Yes	NOC	--	0/7	--	--	1/4	243	MW-20
Naphthalene	91203	Yes	Yes	19,400	HQ = 1	0/7	--	--	2/4	87 - 5,540	MW-20
Phenanthrene	85018	--	Yes	--	--	0/7	--	--	1/4	141	MW-20
Pyrene	129000	Yes	Yes	NOC	--	0/7	--	--	1/4	84	MW-20

Notes:
(1) = Per Table 1 of USEPA. 2004. User's Guide for Evaluating Subsurface Vapor Intrusion into Buildings. Office of Emergency and Remedial Response, Washington, DC. (February 2004)
(2) = Derived using the USEPA version of the Johnson and Ettinger (1991) Model for Subsurface Vapor Intrusion into Buildings accessed at:
www.epa.gov/oswer/riskassessment/airmodel/johnson_ettinger.htm
For groundwater, GW-ADV Version 3.1 02/04. For soil, SL-ADV Version 3.1 02/04
Target risk for noncarcinogenic health effects is a hazard quotient (HQ) = 1. Target incremental lifetime cancer risk = 10^{-6} risk.
(3) = Data for MWs 2, 4, 8, 9, 24, 25, 26
(4) = Data for MWs 19, 20, 22, 27
(5) = Not of concern = the groundwater concentration at or above the solubility limit or the soil concentration at or above the soil saturation limit is not of concern for this pathway
(6) = Based on p-xylene

Table 4
Estimates of Approximate Arrivals Level Areas

Rectangles	Elevation (ft)	Length[1] (cm)	Width[1] (cm)	Length (ft)	Width (ft)		Area (sq ft)	Ceiling Height[2] (ft)
A	8.5	30	12	285	114		32,490	21
B1	8.5	19.5	9.5	185	90		16,719	21
B2	11.17	12.5	9.5	119	90		10,717	19
C1	11.17	20	9	190	86		16,245	19
C2	8.5	11	9	105	86		8,935	21
C3	8.5	29	11.3	276	107		29,575	21
F	11.17	-	-	210	89		18,690	16
Open Gate Area	-	-	-	504	89		44,856	-
Open Area by C2	-	25.5	3.5	242	33		8,055	-
Open Area by B2	-	30.5	3.5	290	33		9,634	-
Triangles	**Elevation (ft)**	**Base[1] (cm)**	**Height[1] (cm)**	**Percent**	**Base (ft)**	**Height (ft)**	**Area (sq ft)**	**Ceiling Height[2] (ft)**
D1	8.5	31	23	10	295	219	3,217	21
	11.17	31	23	90	295	219	28,957	19
D2	8.5	27	23	25	257	219	7,006	21
	11.17	27	23	75	257	219	21,017	19
Arc	**Elevation (ft)**	**Radius 1[1] (cm)**	**Radius 2[1] (cm)**	**Radius 1 (ft)**	**Radius 2 (ft)**	**Arc (degrees)**	**Area (sq ft)**	**Ceiling Height[2] (ft)**
E	11.17	68.2	55.2	648	524	62	78,333	19
							Approximate Total Enclosed Area at 11.17 feet elevation (sq ft) = 173,959	52%
							Approximate Total Enclosed Area at 8.5 feet elevation (sq ft) = 97,942	29%
							Approximate Total Open Area (sq ft) = 62,545	19%
							Approximate Total Area (sq ft) = 334,445	

Notes:

(1) 1 cm = 9.5 ft measured off figure

(2) Ceiling height = (Departures Level elevation - Departures Level floor thickness - Arrivals Level elevation)

Departures Level = 27.17 feet elevation at the gates and 30.17 feet at the ticket hall at the top of the slab

Departures Level floor slab thickness = 5.5 inches (or 0.46 feet)

Table 5
Terminal 5 - Arrivals Level Outdoor Air Volume and Air Exchange Rate Summary

Air Handling Unit[1]	Floor Area[1] (sq ft)	Estimated Area Volume		Outdoor Air Volume[1]		Estimated Approximate Air Exchange Rate	
		Assumed 19' Ceiling (cu ft)	Assumed 21' Ceiling (cu ft)	(cu ft/minute)	(cu ft/hour)	Assumed 19' Slab (#/hour)	Assumed 21' Slab (#/hour)
2	14,142	268,689	296,972	5,162	309,702	0.87	0.96
9	26,980	512,620	566,580	10,154	609,263	0.84	0.93
10	6,206	117,914	130,326	2,267	136,049	0.87	0.96
16	31,485	598,209	661,179	9,173	550,354	1.09	1.20
18, 19 & 26	21,382	406,258	449,022	1,069	64,154	6.33	7.00
24	26,558	504,602	557,718	10,919	655,133	0.77	0.85
25	7,675	145,817	161,167	2,400	144,000	1.01	1.12
28	22,046	418,876	462,968	10,879	652,766	0.64	0.71
32	17,877	339,665	375,419	9,781	586,857	0.58	0.64
33	25,394	482,486	533,274	9,561	573,631	0.84	0.93
37	16,760	318,440	351,960	5,641	338,453	0.94	1.04
Total	216,504	4,113,576	4,546,584	77,006	4,620,362	--	--
Average	--	--	--	--	--	1.35	1.49

Notes:
1 = Data provided by ARUP

Table 6
Parameter Values Input to the J&E Modeling Analyses

Parameter	Symbol	Units	Area E, 11.17' Elev.	Area C2, 8.5' Elev.	Source/Rationale
Average soil/groundwater temperature	T_S	°C	10	10	Default
Depth below grade to bottom of enclosed space floor	L_F	cm	25.4	106.8	Site-specific
Depth below grade to water table	L_{WT}	cm	152.4	152.4	Site-specific
Thickness of soil stratum A	h_A	cm	40.6	122	Site-specific, sub-base
Thickness of soil stratum B	h_B	cm	111.6	30.4	Site-specific, hydraulic fill
Soil stratum directly above water table	--	--	B	B	Site-specific
SCS soil type directly above the water table	--	--	LS	LS	Site-specific, loamy sand
Stratum A SCS soil type	--	--	S	S	Sand, default for crushed stone or concrete
Stratum A soil dry bulk density	ρ_b^A	g/cm^3	1.66	1.66	Default
Stratum A soil total porosity	η^A	unitless	0.375	0.375	Default
Stratum A soil water-filled porosity	θ_w^A	unitless	0.054	0.054	Default
Stratum B soil dry bulk density	ρ_{bB}	g/cm^3	1.62	1.62	Default
Stratum B soil total porosity	η^B	unitless	0.39	0.39	Default
Stratum B soil water-filled porosity	θ_w^B	unitless	0.076	0.076	Default
Enclosed space floor thickness	L_{crack}	cm	25.4	25.4	Site-specific
Soil-building pressure differential	ΔP	g/cm-s^2	40	40	Default
Enclosed space floor length	L_B	cm	8563.3	3200.4	Site-specific
Enclosed space floor width	W_B	cm	8563.3	2621.3	Site-specific
Enclosed space height	H_B	cm	579.1	640.1	Site-specific
Floor-wall seam crack width	WB	cm	0.1	0.1	Default
Indoor air exchange rate	ER	1/h	1	1	Site-specific, average
Depth below grade to top of soil contamination	L_t	cm	121.9	121.9	Site-specific
Depth below grade to bottom of contamination	L_b	cm	0	0	Default
Thickness of soil stratum A	h_A	cm	40.6	121.9	Site-specific, sub-base
Thickness of soil stratum B	h_B	cm	81.3	0	Site-specific, hydraulic fill
Stratum A soil organic carbon fraction	f_{oc}^A	unitless	0.002	0.002	Default
Stratum B soil organic carbon fraction	f_{oc}^B	unitless	0.002	--	Default
Averaging time for carcinogens	AT_C	yrs	70	70	Default, lifetime
Averaging time for noncarcinogens	AT_{NC}	yrs	25	25	Default, occupational lifetime
Exposure duration	ED	yrs	25	25	Default, occupational lifetime
Exposure frequency	EF	days/yr	250	250	Default, worker
Target risk for carcinogens	TR	unitless	1E-06	1E-06	Site-specific
Target hazard quotient for noncarcinogens	HQ	unitless	1	1	Site-specific

Table 7
Risk-Based Screening Levels Sensitivity Analysis

Parameters/Parameter Values			Naphthalene Risk-Based Screening Levels for Groundwater		Methylene chloride Risk-Based Screening Levels for Soil	
			Area E	Area C2	Area E	Area C2
ΔP ($g/cm\text{-}s^2$)	ER (1/hour)	H_B (cm)	11.17 ft Elev. (ug/L)	8.5 ft.Elev. (ug/L)	11.17 ft Elev. (ug/kg)	8.5 ft.Elev. (ug/kg)
40	1	579.1	19,400	--	225	--
40	1	640.1	--	12,500	--	80
10	1	579.1	NOC	--	855	--
1	1	579.1	NOC	--	8,410	--
10	1	640.1	--	26,400	--	317
1	1	640.1	--	NOC	--	3,150
40	0.58	579.1	11,300	--	130	--
40	1.2	579.1	23,300	--	270	--
40	0.58	640.1	--	72,700	--	466
40	1.2	640.1	--	15,000	--	965
40	1	243.8	8,170	4,770	95	31
1	0.58	243.8	NOC	NOC	2,050	696

Notes:
NOC = Not of concern = the groundwater concentration at or above the solubility limit or the soil concentration at or above the soil saturation limit is not of concern for this pathway

ATTACHMENT

GW-ADV, 11.17 FEET ELEVATION

DATA ENTRY SHEET

GW-ADV Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [X]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES [ ]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
108883		Toluene

MORE ↓

ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum directly above water table, (Enter A, B, or C)	ENTER SCS soil type directly above water table	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
			Totals must add up to value of L_{WT} (cell G28)							
10	106.8	152.4	122	30.4	0	B	LS	S		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
S	1.66	0.375	0.054	LS	1.62	0.39	0.076				

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
25.4	40	3200.4	2621.3	640.1	0.1	1	

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	25	25	250	1.0E-06	1
				Used to calculate risk-based groundwater concentration.	

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
7.88E+08	45.6	0.321	0.314	ERROR	0.003	9.92E-08	0.998	9.91E-08	18.75	0.39	0.087	0.303	11,643

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)
1.49E+06	9.63E+06	1.21E-04	106.8	9,154	2.92E-03	1.26E-01	1.75E-04	1.41E-02	1.21E-02	0.00E+00	1.79E-04	4.28E-04	45.6

Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
106.8	1.26E+02	0.10	2.16E+02	1.41E-02	1.16E+03	1.58E+145	4.27E-05	5.37E-03	NA	4.0E-01

END

RESULTS SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)
NA	1.09E+05	1.09E+05	5.26E+05	1.09E+05

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	NA

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)
MESSAGE: The values of Csource and Cbuilding on the INTERCALCS worksheet are based on unity and do not represent actual values.

SCROLL DOWN TO "END"

END

GW-ADV, 8.5 FEET ELEVATION

DATA ENTRY SHEET

GW-ADV Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [X]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES [ ]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
108883		Toluene

MORE ↓

ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum directly above water table, (Enter A, B, or C)	ENTER SCS soil type directly above water table	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
			Totals must add up to value of L_{WT} (cell G28)							
10	25.4	152.4	40.6	111.8	0	B	LS	S		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm³)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm³)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm³)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
S	1.66	0.375	0.054	LS	1.62	0.39	0.076				

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm-s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
25.4	40	8563.3	8563.3	579.1	0.1	1	

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	25	25	250	1.0E-06	1
				Used to calculate risk-based groundwater concentration.	

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
7.88E+08	127	0.321	0.314	ERROR	0.003	9.92E-08	0.998	9.91E-08	18.75	0.39	0.087	0.303	34,253

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)
1.18E+07	7.33E+07	4.67E-05	25.4	9,154	2.92E-03	1.26E-01	1.75E-04	1.41E-02	1.21E-02	0.00E+00	1.79E-04	1.12E-03	127

Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, exp(Pe) (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
25.4	1.26E+02	0.10	7.80E+02	1.41E-02	3.43E+03	4.65E+178	3.00E-05	3.77E-03	NA	4.0E-01

END

RESULTS SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)
NA	1.55E+05	1.55E+05	5.26E+05	1.55E+05

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	NA

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)
MESSAGE: The values of Csource and Cbuilding on the INTERCALCS worksheet are based on unity and do not represent actual values.

SCROLL DOWN TO "END"

END

SL-ADV, 11.17 FEET ELEVATION

DATA ENTRY SHEET

SL-ADV
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED SOIL CONCENTRATION (enter "X" in "YES" box)

YES [X]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL SOIL CONCENTRATION (enter "X" in "YES" box and initial soil conc. below)

YES [ ]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial soil conc., C_R (µg/kg)	Chemical
75092		Methylene chloride

MORE ↓

ENTER Average soil temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to top of contamination, L_1 (cm)	ENTER Depth below grade to bottom of contamination, (enter value of 0 if value is unknown) L_2 (cm)	ENTER Totals must add up to value of L_1 (cell G28) Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
10	106.8	121.9	0	121.9	0	0	S		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum A soil organic carbon fraction, f_{oc}^A (unitless)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum B soil organic carbon fraction, f_{oc}^B (unitless)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)	ENTER Stratum C soil organic carbon fraction, f_{oc}^C (unitless)
S	1.66	0.375	0.054	0.002										

MORE ↓

ENTER Enclosed space floor thickness, L_{concr} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm-s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
25.4	40	3200.4	2621.3	640.1	0.1	1	

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	25	25	250	1.0E-06	1
				Used to calculate risk-based soil concentration.	

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Initial soil concentration used, C_R (µg/kg)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
7.88E+08	15.1	0.321	ERROR	ERROR	0.003	9.92E-08	0.998	9.91E-08	11,643	1.00E+00	1.49E+06

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)	Convection path length, L_p (cm)
9.63E+06	1.21E-04	106.8	7,034	1.16E-03	5.01E-02	1.75E-04	1.63E-02	0.00E+00	0.00E+00	1.63E-02	15.1	106.8

Soil-water partition coefficient, K_d (cm^3/g)	Source vapor conc., C_{source} (µg/m^3)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, exp(Pe^f) (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ (µg/m^3)	Finite source β term (unitless)	Finite source ψ term $(sec)^{-1}$	Time for source depletion, τ_D (sec)	Exposure duration > time for source depletion (YES/NO)
2.34E-02	7.64E+02	0.10	2.16E+02	1.63E-02	1.16E+03	1.18E+125	1.42E-04	1.08E-01	NA	NA	NA	NA

Finite source indoor attenuation coefficient, <α> (unitless)	Mass limit bldg. conc., $C_{building}$ (µg/m^3)	Finite source bldg. conc., $C_{building}$ (µg/m^3)	Final finite source bldg. conc., $C_{building}$ (µg/m^3)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
NA	NA	NA	NA	4.7E-07	3.0E+00

END

RESULTS SHEET

RISK-BASED SOIL CONCENTRATION CALCULATIONS:

Indoor *exposure* soil conc., carcinogen (µg/kg)	Indoor *exposure* soil conc., noncarcinogen (µg/kg)	Risk-based *indoor* exposure soil conc., (µg/kg)	*Soil* saturation conc., C_{sat} (µg/kg)	Final *indoor* exposure soil conc., (µg/kg)
8.04E+01	4.06E+04	8.04E+01	8.55E+05	8.04E+01

INCREMENTAL RISK CALCULATIONS:

Incremental risk from *vapor* intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	NA

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)
MESSAGE: The values of Csource and Cbuilding on the INTERCALCS worksheet are based on unity and do not represent actual values.

SCROLL DOWN TO "END"

END

SL-ADV, 8.5 FEET ELEVATION

DATA ENTRY SHEET

SL-ADV Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED SOIL CONCENTRATION (enter "X" in "YES" box)

YES: X

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL SOIL CONCENTRATION (enter "X" in "YES" box and initial soil conc. below)

YES:

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial soil conc., C_R (µg/kg)	Chemical
75092		Methylene chloride

MORE

ENTER Average soil temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to top of contamination, L_t (cm)	ENTER Depth below grade to bottom of contamination, (enter value of 0 if value is unknown) L_b (cm)	ENTER Totals must add up to value of L_t (cell G28): Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
10	25.4	121.9	0	40.6	81.3	0	S		

MORE

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum A soil organic carbon fraction, f_{oc}^A (unitless)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum B soil organic carbon fraction, f_{oc}^B (unitless)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)	ENTER Stratum C soil organic carbon fraction, f_{oc}^C (unitless)
S	1.66	0.375	0.054	0.002	LS	1.62	0.39	0.076	0.002					

MORE

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP (g/cm-s^2)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
25.4	40	8563.3	8563.3	579.1	0.1	1	

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	25	25	250	1.0E-06	1

Used to calculate risk-based soil concentration.

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Initial soil concentration used, C_R (µg/kg)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
7.88E+08	96.5	0.321	0.314	ERROR	0.003	9.92E-08	0.998	9.91E-08	34.253	1.00E+00	1.18E+07

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)	Convection path length, L_p (cm)
7.33E+07	4.67E-05	25.4	7,034	1.16E-03	5.01E-02	1.75E-04	1.63E-02	1.40E-02	0.00E+00	1.43E-02	96.5	25.4

Soil-water partition coefficient, K_d (cm^3/g)	Source vapor conc., C_{source} (µg/m^3)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, exp(Pe^f) (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ (µg/m^3)	Finite source β term (unitless)	Finite source ψ term $(sec)^{-1}$	Time for source depletion, τ_D (sec)	Exposure duration > time for source depletion (YES/NO)
2.34E-02	6.26E+02	0.10	7.80E+02	1.63E-02	3.43E+03	7.96E+153	6.17E-05	3.87E-02	NA	NA	NA	NA

Finite source indoor attenuation coefficient, <α> (unitless)	Mass limit bldg. conc., $C_{building}$ (µg/m^3)	Finite source bldg. conc., $C_{building}$ (µg/m^3)	Final finite source bldg. conc., $C_{building}$ (µg/m^3)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
NA	NA	NA	NA	4.7E-07	3.0E+00

END

RESULTS SHEET

RISK-BASED SOIL CONCENTRATION CALCULATIONS:

Indoor exposure soil conc., carcinogen (µg/kg)	Indoor exposure soil conc., noncarcinogen (µg/kg)	Risk-based indoor exposure soil conc., (µg/kg)	Soil saturation conc., C_{sat} (µg/kg)	Final indoor exposure soil conc., (µg/kg)
2.25E+02	1.14E+05	2.25E+02	1.04E+06	2.25E+02

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	NA

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)
MESSAGE: The values of Csource and Cbuilding on the INTERCALCS worksheet are based on unity and do not represent actual values.

SCROLL DOWN TO "END"

END

EXHIBIT 2.6

"Terminal 5 Redevelopment Basis of Design"

to Lease No. AYD-350

between

THE PORT AUTHORITY OF NEW YORK AND NEW JERSEY

and

JETBLUE AIRWAYS CORPORATION

For the Port Authority

Initialed:

For the Lessee

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C	Terminal Capacity Analysis	16
D	Program of Requirements	4
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Section 1.0

Basis of Design

jetBlue
AIRWAYS

JFK International
Airport
Terminal 5
Redevelopment

Basis of Design

November 1st 2005

ARUP
Design Manager

Gensler
Architect

DMJM HARRIS
Airside/Landside Engineer

THE PORT AUTHORITY OF NEW YORK AND NEW JERSEY

JOHN F. KENNEDY
INTERNATIONAL AIRPORT

EXHIBIT 2.6

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APPENDICES

Appendix A	Planning Day Schedule
Appendix B	Landside Demand and Traffic Analysis
Appendix C	Terminal Capacity Analysis
Appendix D	Program of Requirements
Appendix E	IT&T Infrastructure and Structured Cabling System
Appendix F	Security Systems

1. OVERVIEW AND EXECUTIVE SUMMARY

1.1 Overview

1.2 Goals and Process

JetBlue is the largest carrier at JFK and will exceed the capacity of its current terminal in 2005. The objective of this project is to develop terminal, airside and landside facilities to support JetBlue's continued growth in a cost-effective and customer-friendly fashion. The project is located behind existing T5 and will consist of a 26 gate terminal building of approximately 625,000 square feet plus connectors to the Airtrain, a new parking garage, and the historical Saarinen building. The current project schedule indicates the opening of the terminal in 2008.

The terminal will be designed to operate at minimum IATA Level of Service C.

Landside Constriants on quadrant growth:
The minimum standard Level of Service 'C' will be maintained on all roadways and intersections within the T5/T6 quadrant.

1.3 Summary and Requirements

A program of requirements for the project has been systematically developed on the basis of a detailed planning day flight schedule and the aircraft, customer, crew, and service functions arising from and necessary to support that schedule. A summary of the primary facility requirements is as follows:

1.3.1 Airside

- 26 N° A320/ EMB 190 compatible contact gates plus a minimum of 8 hardstands
- Dual taxilanes to facilitate simultaneous arriving and departing flights

1.3.2 Terminal Processor

- 12 Curbside check-in positions
- 24 Kiosks for customers with bags
- 20 Kiosks for customers without bags
- 28 Lobby Check-in positions
- 20 Security positions
- 6 Bag Claim Devices (each 150 ft. exposed perimeter)

1.3.3 Landside

Curbs:

Frontage	Modes served		Required Curb Length (ft)
Departures	All modes – common curb		725*
Arrivals	Private vehicles		365*
	For-hire vehicles		100*
	Subtotal – common curbs		*465*
	HOV loading		105
	Taxi loading		150
	Total Arrivals	*720*	

Table 1 - Curb Allocation
* Accounting for 2 stopping lanes

Parking:

New garage providing a minimum of 1,500 net parking spaces. The garage will be designed to operate at a minimum of Level of Service C and subject to a separate Basis of Design document.

Airtrain/ Garage Connector:

An elevated pedestrian connector between the new garage and Airtrain station, and the new terminal. The connector will include moving walkways between the Airtrain station and the terminal building.

Loading Dock:

Six loading bays, two of which will be capable of accepting a 55-foot long articulated semi-trailer truck. It is assumed that 1 to 2 bays would be utilized for dumpsters.

1.3.4 Flight Wing Connector Tubes to Original T5

- The east tube to the demolished Flight Wing 2 will be maintained as a link between the new terminal and the original T5 headhouse, with unobtrusive structural modifications as necessary to span the new arrivals curb with adequate vehicle clearances.
- As stipulated in the MOA the entire visible length of the East Tube will remain
- The east tube will be provided with a stair to link the termination of the tube to the arrivals floor level of the new terminal
- The West Tube is to be modified in accordance with the MOA and if replaced, will be designed to to operate at a minimum Level of Service 'C' to facilitate. Jet Blue customers checking in at proposed kiosks in the Saarinen building and crossing to the

new terminal Any modifications will be coordinated with the proposed adaptive reuse of the Saarinen Building.

- The west tube will be provided with a stair and elevator to link the termination of the tube to the arrivals floor level of the new terminal

2. PLANNING PARAMETERS

2.1 General Project Parameters

The planning day schedule (see Appendix A) is for 248 flights in each direction. This schedule consists of A320 and EMB190 flight movements. The following table contains the enplaning/deplaning and originating/terminating customer loads used in the planning schedule. Note that the transfer percentage, and therefore the originating/ terminating volumes, varies by time of day.

Under the current JetBlue T5 terminal project there are no plans to construct an FIS facility.

Planning Day Schedule Customer Volumes					
Aircraft	Enplaning & Deplaning	Originating & Terminating			
	All Day	Early AM*	AM/PM	Late PM	Latest PM
A320	146	131	117	131	146
EMB190	80	72	64	72	80
Early AM is departures before 9:05 and arrivals before 8:25 AM/PM is departures 9:06-21:29 and arrivals 8:26-20:25 Late PM is departures after 21:30 and arrivals 20:26-22:30 Latest PM is arrivals after 22:30					

Table 2: Planning Day Schedule Customer Volumes

Specific traffic parameters associated with the planning day schedule include:

- Daily Arrivals: 23,240 customers on 248 flights
- Daily Departures: 23,240 customers on 248 flights
- Peak Hour Arrivals (Terminating): 1,970 customers on 20 flights (18:30-19:30)
- Peak Hour Departures (Originating): 2,625 customers on 25 flights (07:45-08:45)
- Additional average 20% transfer customers (varies by time of day)
- Additional 20% well-wishers & greeters

The preceding peak hour volumes are based on flight arrival and departure times. The following are the peak hour volumes of originating/terminating customers entering and exiting the terminal:

Peak Hour Terminating Customers Exiting Terminal: 2,081 (18:50-19:50)

Peak Hour Originating Customers Entering Terminal: 2,279 (6:45-7:45)

The distribution of terminating customers exiting the terminal after arriving on a flight is determined by the interaction of a number of factors including: walking speed, checked baggage characteristics and baggage system performance. A detailed simulation program generated the planning volumes in this project.

The following distribution was used to generate the volume of customers entering the terminal.

Originating Customer Arrival at Terminal	
Time prior to scheduled flight departure (minutes)	Percentage of originating customers entering the terminal
150-120	2
120-100	5
100-80	12
80-60	22
60-40	38
40-20	21
20-0	0
Total	100%

Table 3: Originating Customer Arrival at Terminal

The road system is based on the composite peak hour (entering/exiting) which is slightly off-set from the arrivals peak and has the following characteristics:

Total Customers: 3,624 (18:45-19:45)

Terminating Customers in Composite Peak Hour: 2,020

Originating Customers in Composite Peak Hour: 1,604

2.2 Landside Parameters

On the basis of studies of Jet Blue's Terminal 6 operations, projected key parameters for determining curb requirements are as follows:

Parameter	Arrivals	Departures
Passenger mode split		
Private autos	46%	30%
Taxis	10%	14%
For hire vehicles	12%	16%
Shuttles/limos	6%	19%
AirTrain	26%	21%
Occupancy	**Arrivals**	**Departures**
Private autos	1.9	1.2
Taxis	1.7	1.4
For hire vehicles	2.0	1.5
Shuttles/limos	1.6	4.3
AirTrain	N/A	
Dwell Time (Minutes)	**Arrivals**	**Departures**
Private autos	1.8	1.3
Taxis	1.6	0.9
For hire vehicles	3.0	1.9
Shuttles/limos	2.0	2.2
AirTrain	N/A	

Table 4 - JetBlue landside parameters observed spring 2003

Curb requirements are based on the individual peaks of customers entering and exiting the terminal, as summarized in the following table:

Peak Hour Curb Requirements				
	Time of peak hour	**Customers Entering/ Exiting Terminal**	**Customers at Curb**	**Vehicles at curb**
Arrivals	18:50 – 19:50	2,081	1,540	730
Departures	6:45 – 7:45	2,279	1,800	1,129

Table 5 – Peak Hour Curb Requirements

The following table summarizes the vehicular traffic generated at Terminal 5 during the 18:46-19:45 composite peak hour:

	Customers Entering/ Exiting Terminal	**Customers at curb**	**Vehicles**
Arrivals	2,020	1,495	709
Departures	1,604	1,267	795
Total	3,624	2,762	1,504

Table 6 - Peak hour customer and vehicle traffic, Terminal 5

Within this peak hour, the peak 15 minute period occurs between 19:21 and 19:35, when 1,202 origin/destination customers enter and exit the terminal. The following table summarizes the vehicular traffic generated at Terminal 5 during the peak 15 minutes.

	Customers Entering/ Exiting Terminal	**Customers at curb**	**Vehicles**
Arrivals	875	648	307
Departures	327	258	162
Total	1,202	906	469

Table 7 - Peak 15-minute O/D customer and vehicle traffic, Terminal 5

Additional landside planning parameters are discussed in Appendix B

2.3 Customer Processing Parameters

This section contains the key parameters used to determine the customer processing facilities within the terminal. The generation of facility requirements was performed using a detailed simulation model, as described in Appendix C

Standards:

- The terminal is to generally operate at minimum IATA Level of Service C.

Check-in:

- Customer processing rates: 1 minute for kiosks for customers without bags; 1.5 minutes at kiosk for customers with bags plus 1 minute at bag drop; 2 minutes for curbside, and 2 minutes for full-service lobby counter check-in.
- Customer service maximum wait objectives: 1 minute for kiosks, 5 minutes for curbside, and 10 minutes for full-service lobby counter check-in.
- 35% of customers utilize kiosks without bag check for check-in.
- 25% of customers use kiosks with bag check.
- 10% of customers use curbside check-in (this was also sensitivity tested at 20%).
- 30% of customers use full-service lobby counters (this was also sensitivity tested at 20%).
- All critical planning dimensions will comply with Port Authority Standards contained in Passenger Terminal Planning Standards, (Jan.2004 edition). Cross-circulation dimensions: (Ref. PANYNJ PTPS, item 2.4.1) Ticket counter edge and queue stanchion edge - provide no less than 10' of clearance for customer circulation and ticketing transactions; Queue stanchion edge to edge of building - provide no less than 15' of clearance for two-way customer flow, where physically possible. 10' minimum stanchion protected cross-circulation clearance between curbside check-in positions, and adjacent customer queue (defined with stanchions) will be provided.
- Kiosk and bag drop check-in zones will be provided. A two-step process is proposed. Current layouts are indicative only and a more extensive analysis of layout options will be required. Flexibility is to be provided in the plan to allow kiosk layouts to be altered and/or expanded in future.

Passenger Security Check-point:

- Customer processing rate of 140 per hour for non-selectees and 76 for selectees (12.5% of customers).
- Customer service maximum wait objectives of 10 minutes.
- A queuing zone in front of the security positions will be approximately 20 ft deep, and will be provided with moveable stanchions to create bank queues.
- Provide minimum 10'6" clearance between security queue and processing, based on a flow width of two customers carrying one item of luggage(2'6" per customer with 1'0' buffer one each side) and a 2'6" depth allowance for one customer queuing at the end of the divestiture table (Ref. IATA ADRM (2004), Figure F9.3).
- Security positions will be organized in pairs. Each security position will include two x-ray machines, two magnatometers, one corral for wanding passengers, and one post-security table for hand inspections and trace detections, all as required and agreed with TSA. Each pair of will occupy a footprint approximately 28 ft by 40 feet.
- A post security lateral movement zone of approximately of 12 ft deep is to be provided.

Boarding Concourse Circulation:

- Boarding concourse circulation shall generally be 30 ft wide when serving holdrooms on two sides, and 20 ft wide when serving holdrooms on one side.
- Moving walkways are not required. The suggested maximum walking distance between major functions is 985' (Ref. IATA ADRM (2004), p. 184). The distance from Security to the farthest Holdroom is 920'. The distance from that holdroom to Bag Claim is 940', including an escalator.
- Locations of passenger cross flows and decision making (e.g. the rotunda at the root of the pier) shall be sized to accommodate movement patterns.

Concessions:

- Approximately 62,000 square feet of concessions, including storage and operational space will be provided. A target of 10% will be provided pre security with the remaining 90% target figure provided post security screening

Holdrooms:

- Single holdrooms shall be approximately 1920sq ft. It shall be possible to reduce this size for contiguous holdrooms based on cross-utilization between adjacent areas.
- The stated space allowance includes for circulation 8 ft wide to and from the bridge head.
- A target average of 100 seats per holdroom is to be provided, combined where applicable with adjacent concessions seating. The minimum number of seats per gate on the three concourses will not be less than 85.
- One podium counter approximately 4 ft wide with a queuing zone extending to the primary circulation zone.
- Ticket lift positions will be provided with automated ticket readers.

Arrivals Hall:

- A minimum of 4320sqft to adequately accommodate meeters and greeters without significantly impinging on arrivals flows.
- A 10ft circulation zone is provided between perimeter waiting zones and wall
- Bag claim devices (slope plate carousels) with a waiting zone approximately 12 ft wide around the full perimeter (IATA ADRM (2004) p.187).
- A minimum 10 ft circulation zone between carousels and between carousels and walls.
- A zone for lateral movement along the exterior curb face perimeter not less than 15 ft wide.

Outbound Baggage:

- Two curbside check-in locations with take-away belts are provided. Provision will be made for an oversized conveyor that is accessible from the curb.
- Check in hall conveyors to accept conventional and oversized baggage
- Automatic sortation system
- EDS screening via 10 in-line devices
- Ten x10 ft flatplate make-up units on a 42ft lateral grid

Vertical Circulation:

- Vertical circulation to support anticipated peak usage, with public stairs, escalators and elevators clustered as appropriate.
- Egress stairs to code requirements.

2.4 Terminal Operations Space Requirements

Terminal Processor requirements are summarized in section 1.3.2. Appendix D contains a more detailed description of the Program. This section addresses the operational space requirements.

Space Standards and Gross Area Factors:

- Net departmental space has been calculated on the basis of function and staffing, and increased by 20% to allow for departmental circulation.
- Gross departmental space has generally been increased by a further 20% to 30% to allow for structure, partitions, distributed MEP space and building circulation.
- There is an independent allowance for exterior wall section calculated as a 2-foot-wide band around the perimeter of the building – the areas are indicated in the table below:

	Area Summaries		
	Net Department Area	Gross Department Area	Gross Building Area
Operations			
Aircraft Maintenance	4,429	5,315	6,644
Corporate Security	857	1,028	1,286
Crew Services	1,352	1,622	1,947
Customer Service	12,971	15,565	19,457
Facility Maintenance	9,265	11,118	13,898
Flight Operations	10,144	12,173	14,607
Inflight Services	10,354	12,425	14,910
Information Technology	3,077	3,692	4,837
People Department	3,089	3,707	4,856
Provisions/AC Catering	304	365	456
Ramp Services	10,790	12,948	16,185
System Operations	4,522	5,426	6,783
Tech. Standards (Engineering)	188	226	296
Business Partners			
Cabin Cleaning	1,613	1,936	2,420
Checkpoint Security	2,711	3,253	4,067
Concessions	3,088	3,706	4,632
Fueling	64	77	101
Janitorial Services	4,868	5,842	7,302
Skycap / Wheelchair Services	1,837	2,204	2,756
Others			
Loading Docks	2,948	3,538	4,068
TOTALS	88,471	106,165	131,504

2.5 Terminal Egress Requirements

Based on PANYNJ Tenant Construction Review Manual egress must be sized for a minimum of a 2 hour delay of flights.A summary of calculation methods and key results follow:

1. The total occupant load for the building using the BCCNY load factors is 18,307 occupants. This results in a requirement for approximately 230 units (422 feet) of egress width to be provided throughout the building.
2. The peak hour plus 2-hour delay (3 hour delay) occupant load based on projected ridership data results in 14,320 passengers, meeters and greeters. Adding in support spaces (~2350 occupants) results in a total occupant load of 16,670.
3. The peak hour plus 1 hour delay (2-hour delay) results in a calculated occupant load of 13,120, inclusive of occupants located in support spaces.

2.6 Terminal / AirTrain/ Garage Connector

As part of the Terminal 5 development, JetBlue commit to providing a pedestrian connector between the existing Airtrain Vertical circulation core adjacent to Terminal 6 and Terminal 5. This connector will also serve as a link to the proposed yellow parking garage. The connector will include a grade separated link that crosses the existing Terminal 6 arrivals roadway, and all newly constructed roadways, at a minimum clearance of 14' 6"; a vertical circulation core to bring passengers to grade; and an enclosed link with moving walkways in both directions connecting the vertical circulation core with the terminal. All elements of this connector will be designed to operate at a minimum Level of Service C. Where the connector engages Terminal 5, vertical circulation elements will be provided to allow connection between Departures and Arrivals level.

3. Airside

3.1 Airside Planning

Dual taxilanes have been provided where possible to facilitate the movement of aircraft associated with the planning peak flight schedule. This allows for simultaneous push-back of adjacent aircraft and by-pass ability for arriving aircraft during departing aircraft push-back. The provision of on-apron remote parking/RON positions is also essential to the on-time operation of the airline.

Operational Criteria:

- Minimum 40 minutes for tow-on or tow-off.
- Minimum 20 minutes between two consecutive movements on a gate.

Design Aircraft:

- The apron has been designed to accommodate A320 and EMB190 aircraft, with flexibility built into the design to accommodate A321 where possible

Apron Clearances:

- Apron clearances are based on FAA separation standards for Group III aircraft, including 140 ft. from taxilane centreline to parallel taxilane centerline, and 81 ft. from taxilane centreline to fixed or moveable objects.

Apron Roads:

- A road width of 25 ft. is provided.

Gate Clearances:

- Wingtip clearances between parked aircraft are 25 ft. (This provision is greater than the 15 ft. minimum specified by the FAA for Gate Type A serving Group III aircraft. Aircraft with larger wingspans, such as the B737-900 with winglets, could therefore be gated with reduced wingtip clearances, but in conformance with FAA standards).
- A 5 ft. clearance is provided from aircraft wingtips to apron roads located between parked aircraft, and between aircraft tails and tail-of-stand roads.
- A 30 ft. minimum clearance is provided between noses of parked aircraft and the terminal.
- A 24 ft. minimum clearance is provided between noses of parked aircraft and baggage roads in front of the aircraft.

Passenger Loading Bridges:

- A maximum slope of 1:12 for all three aircraft types.

Jet Blast:

- Jet blast velocities should not exceed 35 mph in areas used by personnel and mobile equipment.

Aircraft Fueling and Apron Slopes:

- NFPA 415 standards for airport terminal buildings, fueling ramp drainage, and aircraft loading walkways.
- Apron slopes should not exceed 1%.
- Ramps used for aircraft fueling to slope away from the terminal with a minimum slope of 1:100 for the first 50 ft. A reduced slope of 1:200 is permitted beyond this distance to drainage inlets.
- Transverse slopes across aprons should not exceed 1:200

GSE Equipment:

- Program requirements for GSE support and maintenance are under development

3.2 Airside Design

3.2.1 Codes, Standards and References

- FAA AC 150/5300-13 "Airport Design"
- FAA Federal Aviation Regulations Part 107 – airport security
- Applicable FAA Advisory Circulars
- PANYNJ "Civil Engineering Design Guidelines"
- PANYNJ Tenant Alteration Procedures and Standards Guide
- PANYNJ Tenant Construction Review Manual
- AASHTO (2001): A Policy on Geometric Design of Highways and Streets
- NFPA 415 "Standard on Airport Terminal Buildings, Fueling Ramp Drainage, and Loading Walkways"

3.2.2 Scope

Airside design associated with proposed improvements to the existing airside apron will include the entire Air Operation Area (AOA) from the terminal to the perimeter lease line bounded by Terminals 4, 6 and the PANYNJ Restricted Service Road (RSR). This

includes the hardstand parking area on Parcel 'Z' adjacent to the switch house building, and taxilane between Terminals 4 and 5.

Airside elements to be designed include:

- Apron Grading
- Taxilane centerline alignments
- TOS and RSR roadways
- Jetblast deflection fence
- Apron lighting
- Hydrant Fueling
- Glycol Storage and Dispensing Station
- Triterator

3.2.3 Design Criteria and Assumptions

3.2.3.1 Apron Grading

The apron will be re-graded to meet the new terminal building first floor elevation and provide for drainage outside of the aircraft gear locations. The limits of this regrading will be between the proposed terminal building and approximately the outer edge of the TOS roadway. Isolated "low-points" at existing catch basins outside of the TOS roadway will also be adjusted. Runoff from all new full depth pavement replacement will be collected within the T5 leasehold. All current drainage collected within the T5 Leasehold is to remain collected within the T5 Leasehold

Maximum grades will be in accordance with FAA AC 150/5300-13 "Airport Design" and NFPA 415 "Standard on Airport Terminal Buildings, Fueling Ramp Drainage, and Loading Walkways" to meet FAA Aircraft Group III and Approach Category C requirements.

3.2.3.2 Taxilane Centerline Alignments

The taxilane centerline alignments design will be based on applicable FAA Advisory Circulars. The alignments will incorporate the following:

- Pavement marking centerline
- Pavement marking hold bars
- Hold position lights

3.2.3.3 TOS and RSR Roadways

The TOS and RSR designs will be based upon applicable FAA Advisory Circulars, Port Authority "Civil Engineering Design Guidelines", and AASHTO (2004): A Policy on Geometric Design of Highways and Streets. The design will include geometric layouts for pavement marking edgelines and centerlines.

3.2.3.4 Jetblast Deflection Fence

A Jetblast Deflection Fence will be positioned, if required, for the location at the rear of Gates 14, 15, and 16 to provide jetblast protection to the existing RSR. A manufactured fence such as the Blast-Safe system by Transpo Industries will also be considered. The location and height of the Jetblast Deflection Fence will be based upon the proposed aircraft operations at these gates as well as the control tower line of sight. The blast fence will be providing protection required to withstand the 35 mph breakaway thrust at the RSR edge.

The height of the fence will be checked against the Port Authority's line of sight restrictions between the control tower and T/W "A". This fence height will be used with the aircraft lead-in lines and primarily Airbus A-320 jet blast cones to determine jetblast protection provided at the RSR edge. The fence will also be checked using the design mix aircraft jetblast cones.

This will be coordinated with aircraft operations to determine if any gate operation restrictions are required.

3.2.3.5 Apron Lighting

The lighting levels for the apron will be between two to five foot candles adjacent to the terminal building and between two and five foot candles on the hardstand parking areas. These lighting criteria will be utilized to design apron lighting provided as follows:

- Lighting on the apron at the aircraft gates will be provided by lighting mounted on the terminal building.
- Lighting for the hardstand parking area may be provided, under the current project scope requirements, by high mast lighting. The airside design will incorporate the requirements for the structural, electrical, and site locations for these lights.

3.3 Paving

3.3.1 Codes, Standards and References

- FAA AC 150/5320-6D "Airport Pavement Design and Evaluation"
- Port Authority "Civil Engineering Design Guidelines"
- Port Authority Tenant Construction Review Manual
- Applicable FAA Advisory Circulars
- NFPA 415 "Standard on Airport Terminal Buildings, Fueling Ramp Drainage, and Loading Walkways"

3.3.2 Scope

Airside paving will be performed to replace the pavement between the proposed terminal building and the limits of apron grading at approximately the outer edge of the TOS roadway. Airside pavement within the lease limits (including Parcel 'Z') but outside of the TOS roadway will be removed and replaced as required based upon the Pavement Condition Evaluation. The following criteria will be considered in conjunction with engineering judgement to deteremine the pavement replacement needs outside of the TOS roadway in addition to a pavement condition evaluation

- Shared use of taxilane and mix of aircraft
- Magnitude of utility relocations and removals

3.3.3 Design Criteria and Assumptions

New full depth pavement replacement will be designed to accommodate Group IV aircraft.

The existing airside pavement is primarily portland cement concrete (PCC) pavement (12"-14" thick) with an area of asphalt concrete (AC) pavement used as patches and in the areas by the existing switch house building and Parcel 'Z'.

The pavement within the TOS roadway will be replaced with a 12"-14" PCC pavement or an equivalent AC pavement.

The pavement outside of the TOS that is determined to require replacement in the Pavement Condition Evaluation will have two possible pavement sections.

Areas of aircraft operations along the taxilanes or at the hardstands will have a 12"-14" PCC pavement or an equivalent AC pavement.

Areas not subject to aircraft operations will have a pavement section with 2" AC pavement, 6" plant mix macadam, and 6" aggregate base course to accommodate the anticipated vehicular usage. Areas that are not constructed for aircraft loading will be indicated as such with signage or striping.

3.4 Aviation Services

3.4.1 Codes, Standards and References

- Port Authority "Civil Engineering Design Guidelines"
- Applicable FAA Advisory Circulars

3.4.2 Scope

Aviation services to be designed include:

- Triturator
- Snow melter discharge

Requirements for preconditioned air and 400 Hz ground power are provided under the terminal building engineering section below.

3.4.3 Design Criteria and Assumptions

3.4.3.1 Snow Melter Discharge

Discharge from a portable snow melter will be via a designated chamber, or series of chambers within the storm water drainage system, which are to be specifically designed to accommodate the discharge.

3.4.3.2 Triturator

A triturator will be designed to provide disposal from aircraft bulk tanks into the sanitary sewer system. The size of the triturator will be based upon the disposal operations for the aircraft.

3.5 Site Preparation / Demolition

3.5.1 Codes, Standards and References

Applicable codes outlined in design sections as well as applicable, industry standard environmental codes.

3.5.2 Scope

Site preparation and demolition associated with proposed improvements to the airside apron. In order to allow for construction of the terminal building, this work may include relocation of utilities, temporary grading, temporary paving and other incidental construction.

3.5.3 Design Criteria and Assumptions

Site preparation will include the removal and disposal off site of any excess not required for crushing and reuse of existing curbs, concrete islands, asphalt or concrete pavements, fences, concrete barriers, guide rail, and unsuitable excavated materials.

Utility structures (catch basins and manholes) will be demolished and removed. Sections of pipes (drainage, sanitary or water lines) may be removed or capped and left in place.

Concrete may be crushed and used as fill within the site

3.6 Hydrant Fueling

3.6.1 Codes, Standards and References

- Air Transport Association (ATA) – Airport Hydrant Systems, An Overview
- National Fire Protection Association (NFPA) 70 – National Electric Code
- New York City Electric Code
- NFPA 407 – Standard for Aircraft Fuel Servicing
- American Petroleum Institute (API) 6D – Specification for Pipeline Valves
- National Association of Corrosion Engineers (NACE) Standard RP-01-69 (1972 revision) - Control of External Corrosion on Underground or Submerged Metallic Piping Systems
- New York State Department of Environmental Conservation (NYSDEC) – Parts 613 and 614
- Port Authority Tenant Construction Review Manual
- Port Authority MOSF license requirements

3.6.2 Scope

The hydrant fueling system design will consist of a fuel distribution system that will provide hydrant fueling to all twenty-six (26) gates of Terminal 5. The system will include hydrant fuel pits, valve vaults, high point vents, low point drains, surge suppressors systems, emergency shutdown systems, a pipeline cathodic protection system and connections to allow for pipeline tightness testing by a mobile testing unit to satisfy NYSDEC periodic tightness testing requirements. The fuel distribution system will be connected into the existing Port Authority breakout pit serving the Terminal 5 site, which is supplied by the Authority's fuel transfer lines from the Airport's Satellite Fuel Farm.

The fuel distribution system will be designed to include future connection to the Terminal 6 hydrant fueling distribution system.

As described the distribution system cannot be connected into the existing PA breakout pit (isolation pit) serving the existing T5, as the new Terminal's footprint is centered over it. Maintaining the access for pig indicator and pig receiving will be required at a new isolation pit

3.6.3 Design Criteria and Assumptions

3.6.3.1 Existing Conditions

The Terminal 5 tenant lease area is served by three (3) 14-inch diameter fuel transfer pipelines supplied from John F. Kennedy International Airport's Satellite Fuel Farm Facility. A series of pipeline subsystems connected to these three distribution lines serve the gates at the main terminal building as well as several hardstand aircraft parking positions. All of these fuel lines are comprised of single wall carbon steel piping with a protective tar coating enclosed by an asbestos paper wrap. As part of the Port Authority's Major Oil Storage Facility agreement with the NYSDEC, the three (3) 14-inch diameter fuel transfer pipelines, hardstands and terminal piping systems were tested with a state-of-the-art pressure based leak detection system in August of 2000. All of the pipelines tested tight with no leaks.

3.6.3.2 Analysis of Existing Fuel Supply System

Presently the fuel for each of the three (3) existing 14-inch fuel transfer pipelines serving Terminal 5 is supplied by three (3) 1,200 GPM rated pump and filter sets. However, due to existing antiquated equipment and controls, the total existing fuel pumping capacity serving Terminal 5 has been calculated to be approximately 6,500 GPM.

3.6.3.3 Design Criteria and Piping Materials

Piping will be of single wall carbon steel construction. The carbon steel piping will be internally epoxy lined and will be externally coated with a fusion bonded epoxy coating system in order to protect the piping from external corrosion. The pipelines will be further protected against external corrosion by employing an impressed current cathodic protection system.

3.6.3.4 Leak Detection

The current requirement of the airport's pressurized underground fuel pipelines, as dictated by the NYSDEC, is a tightness testing frequency of once every ten years. As previously mentioned the existing hydrant fueling distribution system has been recently tested tight. The new hydrant fueling system piping will be designed with the necessary appurtenances required for hookup of a mobile pressure-type state-of-the-art pipeline leak detection system.

3.6.3.5 Hydrant Fueling System Layout

The hydrant fueling distribution system layout will be comprised of two independent piping subsystems. Each subsystem comprising of two independent fuel pipelines, will serve each hydrant pit location. This allows for continuous fuel supply to each hydrant pit location should either fuel pipeline be taken out of service for maintenance or repair. Each of the two piping subsystems will be connected into the Authority's existing three (3) transfer pipelines serving Terminal 5 via a new manifold valve vault located downstream and adjacent to the existing breakout pit serving the Terminal 5 site.

The fuel distribution system will incorporate several pipeline isolation/sectionalizing valve vaults, which will allow for flexibility in maintaining continuous operation, should the normal two independent fuel pipeline operation not be available. High point vent lines will be provided at all system high points to allow for air removal from the system pipelines. Low point drain lines (pump-outs) will be provided at all system low points to allow for removal of fuel from the system pipelines.

The hydrant fueling system will also include a new breakout valve vault to be installed in the system adjacent to the lease line between Terminal 5 and Terminal 6. This vault will allow for future connection of the Terminal 6 hydrant fueling system into the Terminal 5 hydrant fueling system.

3.6.3.6 Emergency Fuel System Shutdown

In accordance with NFPA 407, an emergency fuel shutoff (EFSO) station will be installed at each aircraft fueling position with identifying signage. Activation of any one of the EFS stations will cause shutdown of all of the hydrant fueling pumps at the Satellite Fuel Farm that serve Terminal 5. EFSO notification signals will be sent both to the service provider and the Fire Alarm Command Center. A master EFSO station will be located in the Terminal Control Room.

3.6.3.7 Pipeline Cathodic Protection System

The hydrant fueling system piping will be protected from external corrosion by an impressed current cathodic protection system. This system will consist of several deep well sacrificial metal (anode) ground bed/electric rectifier station systems bonded to the underground piping. Test stations will be strategically located throughout the hydrant fueling system to allow for required periodic testing in accordance with NYSDEC regulations and to determine whether any adjustments to the rectifier systems need to be made. Remote monitoring unit(s) will also be provided in the Terminal's cathodic protection system to allow for tie-in into the Airport's centralized cathodic protection monitoring system.

3.6.3.8 Surge Suppression System

The hydrant fueling equipment and piping will be protected from damaging hydraulic surges (water hammer) created by both normal fueling operations and emergency fueling system shutdowns by surge suppressors that will be strategically located along the hydrant piping system. These surge suppressor tanks contain nitrogen filled bladders that compress during a surge event thus absorbing and dissipating the surge energy. In following Port Authority requirements, the amount of nitrogen contained in the bladders will be both locally monitored using control panels with alarms and fitted with transmitters allowing for remote monitoring.

3.6.3.9 Removal of Existing Hydrant Fueling Distribution System

The existing hydrant fueling system at the Terminal 5 site, although inactive, is still full of fuel. In order to remove those portions of the existing system that will interfere with the construction of any of the new work, including the new terminal and utilities, the system shall first be completely drained, vapor-freed and rendered safe for cutting. Once the system has been made so, then excavations can be performed to identify exactly the

portions of the system to be removed. Where the existing piping is covered with asbestos containing material (ACM) it must first be abated before any pipe cutting can take place. Pipe cutting shall be by cold cutting methods. All aboveground equipment and equipment in pits, including the pits, related to the hydrant fueling system in the Terminal 5 area will be removed. All pipelines which will not interfere with the new work will be abandoned in place. Abandonment will entail pump fill with concrete slurry of the lines and capping of the ends.

3.6.3.10 Modifications to Existing Pump Control System

Currently, the existing pump control system controls each of the three (3) pumps sets independently. That is, each pump set supplies fuel only to the corresponding 14-inch transfer line serving the Terminal 5 site. In order to allow all three (3) of the 14-inch transfer lines to serve the two lines of the new hydrant fueling distribution system, the existing pump control system, which is located at the Airport's Satellite Fuel Farm, must be upgraded and modified to attain the proper pump start/stop operational sequencing.

4. LANDSIDE

4.1 Roadway Design

4.1.1 Codes, Standards and References

- AASHTO (2004): A Policy on Geometric Design of Highways and Streets
- AASHTO (2002): Roadside Design Guide
- FHWA: 2003 Manual on Uniform Traffic Control Devices (MUTCD)
- Transportation Research Board Highway Capacity Manual (2000 Ed.)
- PANYNJ "Civil Engineering Design Guidelines"
- Port Authority 2001 Airport Signing Standards Manual
- NYSDOT Highway Design Manual Volumes I and II - 1998
- Applicable FAA Advisory Circulars
- Americans with Disabilities Act (ADA) applicable standards
- AASHTO: Standard Specifications for Highway Bridges
- PANYNJ Tenant Alteration Procedures and Standards Guide
- PANYNJ Tenant Construction Review Manual
- As required, VMS signs will be as per PANYNJ specifications

4.1.2 Scope

There are 7 components to the roadway works:

- At grade arrivals frontage roadways and ramps. Note: Arrivals frontage curb is designed as part of the Terminal Building Package.
- At grade and elevated departures roadways and ramps. Note: Elevated departures frontage roadway and curb are designed as part of the Terminal Building Package.
- At grade loading dock and connecting roadways to the southwest corner of the Terminal 5 building.
- Connecting roadways to existing "A" Road, TR Road, new garage and existing Saarinen Building frontage road.
- Intersection #42 reconstruction.
- Maintain T6 Arrivals and Departures roadways.
- Traffic control, signage, VMS, pavement markings, pedestrian wayfinding, etc

Roadway elements to be designed include:

- Horizontal and vertical alignments, including superelevation.
- Roadway typical cross sections.
- Roadway grading, spot elevations and vertical clearances.
- Roadway at-grade pavement design.
- Sidewalk, curbs and raised medians. Note: Frontage sidewalks are designed as part of the Terminal Building Package.
- Traffic barriers and guardrails.
- Ancillary structures including bus shelters, taxi dispatch booths, street lighting and wind screens

4.1.3 Design Criteria and Assumptions

4.1.3.1 Horizontal and Vertical Geometry

Design Speed		30 mph	25 mph	20 mph	15 mph
Minimum Radius		*230' 300'	*150' 205'	*90' 125'	*50' 70'
Maximum Superelevation		**4%	**4%	**4%	**4%
Stopping Sight Distance		200'	155'	115'	80'
Absolute Maximum Grade		6%	6%	6%	6%
Desirable Maximum Slope		5%	5%	5%	5%
Absolute Minimum Slope		0.3%	0.3%	0.3%	0.3%
Speed Change Lane		No	No	No	No
Minimum K	Sag	37	26	17	10
	Crest	19	12	7	3

Table 8 – Horizontal and Vertical Geometry

*Derived from PA Landside Technical Design Criteria.

**A maximum 2% cross slope shall be used for the active passenger curbs.

4.1.3.2 Roadway Width

Proposed Departures Roadway widths shall be based on 2001 AASHTO Traffic Condition B for CASE III traffic flow.

Radius on Inner Edge	Roadway Width
50'	36'
75'	33'
100'	31'
162'	28'
200'	28'
300'	28'
400'	28'
500'	28'
Tangent	28'

Table 9 - Case III - Two Lane operation either one way or two way

Proposed Arrivals Roadway widths shall be based on 2001 AASHTO Traffic Condition C for the CASE III traffic flow.

Radius on Inner Edge	Roadway Width
50'	45'
75'	38'
100'	35'
162'	*28'
200'	*28'
300'	*28'
400'	28'
500'	28'
Tangent	28'

Table 10 - Case III - Two Lane operation either one way or two way

*Indicates roadway widths under ASSHTO Standards due to limited structural constraints.

Proposed Loading Dock Roadway widths shall be based on 2001 AASHTO Traffic Condition C for the CASE II traffic flow.

Radius on Inner Edge	Roadway Width
50'	30'
75'	27'
100'	25'
162'	23'
200'	22'
300'	22'
400'	21'
500'	21'
Tangent	20'

Table 11 - Case II – One Lane, One way operation with provisions for passing stalled vehicle

Roadway widths within the existing roadways will be consistent with the existing dimensions. The proposed taxi stack area to be a minimum two lane width of 22' and a minimum three lane width of 30'.

4.1.3.3 Curve Widening

Curve widening shall be applied over the length of the horizontal transition curve. If horizontal transition curves are not used, curve widening will be applied over the super elevation runoff length.

In all cases, curve widening will not be applied at a rate greater than 1:15.

4.1.3.4 Sidewalks

Along arrivals roadway approach roadway, a five (5) feet sidewalk will be provided along roadways and island allowing pedestrians to access to the terminal building. Frontage sidewalks are designed as part of the Terminal Building Package.

4.1.3.5 Shoulders

On Structure – Provide 2 feet safety walks on both sides of the road behind 6" non-mountable curbs.

On Grade – Provide 2 feet asphalt block paver shoulders behind 6" non-mountable curbs on both sides where possible.

4.1.3.6 Fixed Roadside Objects

Provide guide rail, concrete barriers and impact attenuators as required to protect vehicles and pedestrians from existing and proposed fixed roadside objects.

Impact attenuators will be installed at the gore areas of diverging roadways on structures and on grade and will transition to the guide rail (in accordance with NCHRP350).

Proper protection or sufficient roadside clearance to fixed objects will be provided. At areas where the roadside clearance is less than adequate, guide rails will be installed at the roadside.

4.1.3.7 Signage

All roadway signage will follow both the FHWA 2003 MUTCD and Port Authority's Airport Signing Standards Manual. All pedestrian wayfinding signs will conform to the Airport Signing Standards Manual. All Terminal 5 signage will be clear and direct for pedestrians and motorists, utilizing color-coding and symbols to enhance wayfinding. Also, variable message signs will be installed, where appropriate, informing motorists of parking and terminal level closures.

4.1.3.8 Vertical Clearance

The following minimum vertical clearances will be provided:

Item	Minimum Vertical Clearance
Roadway, Existing AirTrain Guideway and New Connector Tube #1 & (3) 12'-Bypass Lane under Existing Connector Tube #2	14.5'
(2) 10'-Lane under Existing Connector Tube # 2 for Taxi Queue Only	Approx. 10.0' (TBV)
Overhead Sign Structure	15.5'
Overhead Traffic Signal.	16'

Table 12 – Vertical Clearance

4.1.3.9 Super elevation

The roadway and shoulder cross slope on proposed straight as well as curved sections of roadway and ramps shall be 2% across entire roadway. No normal crown will be used.

In areas where the proposed ramps and roadways meet existing at-grade roadways, existing superelevation rates shall be maintained and transitioned back to normal cross slopes as required.

4.1.3.10 Roadway Layout

Arrivals and Departures Roadways

Arrivals frontage roadway shall consist of two 10-foot pick-up lanes, one 12-foot maneuvering lane and two 12-foot bypass lanes. The arrivals roadway shall be provided with 2 feet shoulder and 2 feet safety walk on the inside curve of the road. A retaining wall with safety railing/fence shall be provided on the arrivals roadway adjacent to the Saarinen building future courtyard (by others).

Arrivals frontage roadway horizontal design shall not interfere with the east tube connector from the existing Saarinen Building and all its supporting columns.

The vertical clearance between the approach arrivals and departures roadways and the existing AirTrain guideway shall be a minimum of 14.5 ft. When the approach departures roadway intersects with the arrivals roadway, a minimum 14.5 ft vertical clearance shall be applied. The profile of the arrivals frontage roadway (3 bypass lanes) passing under the east tube connector of the Saarinen building shall provide for a minimum clearance of 14.5', with the exception for the two 10' taxi queue lanes underclearance shall be approximately 10' (TBV). Protection against an over height vehicle entering the taxi lane will be provided.

The arrivals and departures ramp termination points with Intersection #42 shall meet with the existing grade and pavement.

The west tube connector shall be demolished and rebuilt. This work will be coordinated with the roadway vertical geometry design.

In Phase I of the project, the elevated northern departures frontage roadway/ramp shall be provided with a stub for future roadway extensions. The northern arrivals roadway shall be designed to provide space for the departures ramp. The departures ramp shall be replaced with the Phase II departures roadway concentric with the Phase II arrivals roadway. The design of the Phase I roadway shall not preclude a Phase II expansion.

4.1.4 Loading Dock

A loading dock shall be provided at the southeast corner of the proposed terminal 5. The loading dock shall consist of 6 depressed bays. Each bay shall be depressed 4 ft.

The loading dock shall accommodate two (2) bays for WB-50 trucks, (2) bays for dumpsters or roll-on/roll-off trucks, and (2) bays for SU-30 trucks.

The placement of the columns supporting the above departures ramp structure shall be designed to avoid conflicts with truck maneuvers.

The full width of the loading dock area shall be dictated by the maneuvering of the WB-50 truck (i.e., 90-degree turn) and evaluated based on review of simulations of the design vehicle using the simulation program, AutoTurn 4.2.

4.2 Departures Ramp Structures

4.2.1 Codes, Standards and References

- AASHTO Standard Specifications for Highway Bridges, 17th Ed, and NYSDOT Standard Specifications for Highway Bridges 2002 (Blue Pages)
- Applicable FAA Standards
- ASTM Standards, Latest Revisions
- PANYNJ Tenant Alteration Procedures and Standards Guide
- PANYNJ Tenant Construction Review Manual
- NYSDOT Bridge Manual 3rd Edition 2002
- Highway Standard Specification for structural supports for highway signs, luminaries and traffic signals)

4.2.2 Scope

The departures ramp structures shall be designed in accordance with the currently recognized structural design standards, modified or augmented as detailed in this section.

In addition to bridge and site specific criteria, pertinent sections of the following standards or codes have been employed for such modifications or augmentations.

Piers and abutments will be pile supported. Superstructure will be three-span and two-span continuous with expansion joints to allow for thermal movement. Steel pier cap beams will support multi-girder steel stringers. Concrete abutments and piers will have multi-rotational bearings to support steel superstructures.

4.2.3 Design Criteria and Assumptions

4.2.3.1 Roadways

Number of Lanes	Two-lane ramps
Width	AASHTO 3.6
Design Vehicle	HS 20
Pedestrian Provisions	None, 2' Safety walk
Median Treatment	None
Curb Usage And Type	Non-mountable curb with parapet
Illumination	Standard illumination – parapet mounted
Maximum Cross Slope Ratios	2%
Surface Treatment	Micro-silica concrete overlay
Degree of Access Control	Controlled access facility

4.2.3.2 Clearances Standards

Roadway:	
Horizontal	AASHTO
Vertical	AASHTO

4.2.4 Design Loads

Structural Dead Loads-DL	AASHTO 3.3
Unless specified herein or in the contract drawings, all loads shall be as specified in the Codes and Standards.	AASHTO 3.3.6
Concrete The in service air dry unit mass of normal weight Concrete, including reinforcements	(w_{conc} - 150 lb/ ft^3

Other Permanent Loads- SDL

Other permanent loads are considered to be applied at the time of construction except for utilities and other appurtenances, if applicable.	AASHTO 3.3
Vehicular Barrier/ Pedestrian Barrier	Single slope or Jersey slope concrete barrier with parapet safety walk and top rail
Wearing Surface, Deck Slab	2" wearing surface with varying deck slab of minimum 8" thickness
Live Loads- LL+I	AASHTO 3.4-3.8, 3.11-3.12, 3.14
Vehicle Type	HS 20
Design Speed	25 mph
Live loads shall be considered for two lanes	Impact to be considered as per highway traffic with safety walks on both sides AASHTO
Standard Truck and Lane Loads	AASHTO 3.7
Vehicular live load	AASHTO 3.6.4 &3.11
Vehicle live loads shall be positioned both transversely and longitudinally so as to produce the maximum influence on the structure	

Load reduction factors for multiple lane loading	No reduction
Pedestrian Loads	AASHTO 3.14.1
Live Load Contribution Under Seismic Conditions A reduced live load shall be considered for combination with seismic demands (Group VIIA loading).	
Sidewalk, Curb and Railing Loading	AASHTO 3.14.1
Impact shall not be included	AASHTO 3.8.1.2
Longitudinal Forces-LF	AASHTO 3.9
Thermal Effects-T Uniform Temperature-Tc and Ts Design Temperature range shall correspond to AASHTO 3.16	AASHTO 3.16
Moderate climate: Concrete Structure Steel Structure (Range of Temperature)	Rise (T)Fall(T) 30° 40° 0° to 120°
Coefficient of Thermal Expansion Normal weight concrete Steel	 6.0×10^{-6}/°F 6.5×10^{-6}/°F
Concrete Shrinkage	AASHTO 8.5.4
Wind Wind on Structure (W) Wind on Live Load (WL) Wind-superstructure design Wind-substructure design	AASHTO 3.15 AASHTO 3.15.1 AASHTO 3.15.2
Uplift	AASHTO 3.17
Earth Pressure Soils Density	AASHTO 3.20. As available from Geotechnical borings, Or : $(_{SOIL}$ - 120 lb/ ft^3
Lateral Soil Pressure	AASHTO 3.20.1 & 3.20.2, Div-IA
Live Load Surcharge	AASHTO 3.20.3 & 3.20.4
Centrifugal Forces	AASHTO 3.10
Buoyancy	AASHTO 3.19
Earthquakes	AASHTO 3.21, AASHTO Div. I-A and NYSDOT Specifications (Blue Pages) for Essential Bridges.

4.2.5 Combination of Loads

Service and Load Factor Design

Loading combinations shall be in accordance with Tables 3.22.1A AASHTO Standard Specifications for Highway Bridges, 17th Ed	AASHTO 3.22
Dead Load-D shall include structural dead loads (DL), other permanent loads (SDL) and erection loads (EL) where applicable	$Group(N) = \gamma(B_D D + B_L(L+I) + B_C CF + B_E E + B_B B + B_S SF + B_W W + B_{WL} WL + B_L LF + B_R(R+S+T) + B_{EQ} EQ + B_{ICE} ICE)$
Group Loading Combinations for Service Load Design and Load Factor Designs are given by:	As defined in AASHTO 3.22.1

4.2.6 Allowable Stresses

For different materials at different loading Conditions:	AASHTO Section 8

4.2.7 Materials

4.2.7.1 Concrete

Superstructure Normal weight concrete: 28-day minimum strength	 $f_c = 5{,}000$ *psi.*
Substructure Normal weight concrete:	

	28-day minimum strength	$f_c = 5{,}000\ psi$
	Foundation Normal weight concrete: 28-day minimum strength	$f_c = 5{,}000\ psi$

4.2.7.2 Reinforcing Steel

	Properties ASTM A 615 (AASHTO M31) Grade 60 Deformed and Plain Billet-Steel Bars for Concrete Reinforcement	$f_y = 60ksi$
	ASTM A 775 (AASHTO M284) Epoxy-Coated Reinforcing Steel Bars	$f_y = 60ksi$

4.2.7.3 Structural Steel

	Structural Steel shall comply with the AASHTO Materials Specifications, and ASTM Standards.	AASHTO-M270

4.2.7.4 Miscellaneous Steel

	High Strength Bolts	ASTM A325
	Expansion Joints Bridge expansion joints shall be designed for movement demands from temperature rise and fall, creep and shrinkage, and functional evaluation earthquake.	

4.3 Paving

4.3.1 Codes, Standards and References

- NYSDOT Highway Design manual Volumes I and II 1998

4.3.2 Scope

Pavement elements to be designed include:

- Pavement types and depths of construction
- Curb types and locations
- Shoulders
- Median treatments

4.3.3 Design Criteria and Assumptions

4.3.3.1 Pavement Types

All at-grade landside roadway pavements shall be flexible pavement based on H20-S16 loading.

The typical flexible pavement section for the different roadways are as followed below. All sub-base materials are to be compacted as specified.

Arrivals and Departures Roadways and Ramps:

4" Asphalt Concrete Top Course

4" Plant Mix Macadam

6" Dense Graded Aggregate Base Course

The Loading dock to require an 8" thick reinforced concrete slab on a 12" compacted dense graded aggregate sub-base.

4.3.3.2 Curbs

All roadways will have 6" non-mountable concrete curbs along all sidewalk and raised median areas.

4.3.3.3 Shoulders

On at-grade roadways with shoulders, a retaining wall will be provided for all sections with a 2 feet or more difference in grade elevations.

Concrete barriers and guide rails will be used where necessary.

The maximum earthworks slope for cuttings and embankments is 2:1.

4.3.3.4 Median Treatment

PA standard block pavers shall be used for all raised median areas. Landscaping to be determined at a later date.

4.4 Site Services

The following landside amenities located on the frontage curbs are designed as part of the Terminal Building Package.

- Canopies
- Taxi Booth
- Guard Booth at Loading Dock
- Electrical Outlets
- Hose Bibbs
- Fire Alarm Boxes

4.5 Site Preparation / Demolition

4.5.1 Codes, Standards and References

- PANYNJ Tenant Alteration Procedures and Standards Guide
- PANYNJ Tenant Construction Review Manual

4.5.2 Scope

Site preparation and demolition associated with the proposed construction of the new Terminal 5 building and roadways will occur at airside and landside.

The following existing features at the present Terminal 5 location will be demolished prior to construction activities for the new Terminal 5 :

- Airside Buildings
- Airside Outbound Baggage Building
- Baggage Handling Structures between T-6 and T-5
- Miscellaneous Structures
- Landside Surface Elements

4.5.3 Design Criteria and Assumptions

Site preparation will include the removal of existing concrete curbs, raised concrete medians and islands, asphalt and concrete pavements, sidewalks, fences, concrete barriers, guide rails, signage, cleared and grubbed items and unsuitable excavated materials.

Utility structures (catch basins, drainage inlets, manholes, pull boxes) shall be demolished and/or removed as required. Sections of pipes (drainage, sanitary, water, or gas) may be removed or plugged and left in place as required.

5. GEOTECHNICAL DESIGN

5.1.1 Codes, Standards and References

- New York City Building Code 1999
- AASHTO American Association of State Highway Transportation Officials 1996
- PANYNJ Tenant Alteration Procedures and Standards Guide
- PANYNJ Tenant Construction Review Manual

5.1.2 Scope

Foundation design associated with proposed Terminal Building and Approach Roadways.

- Subsurface Investigation program consisting of borings and CPT testing
- Liquefaction Analysis
- Foundation for elevated roadways
- Abutments for elevated roadways
- Subgrade for at grade roadways
- Subgrade for airside pavement
- Foundation for Terminal Building
- Foundation for utility structures

5.1.3 Design Criteria and Assumptions

5.1.3.1 Subsurface Investigation

Boring and CPT results were utilized to evaluate the soil condition at the site, determine the stratigraphy and determine soil parameters to be used in design. The analysis of the results indicated that the soil strata were layered as follows:

a. Hydraulic Fill - This layer begins below the concrete pavement and consists of seven (7) to fourteen (14) feet of hydraulic fill. The hydraulic fill is predominantly sand with varying amounts of silt and gravel. From standard penetration tests the upper material is generally dense, the lower two to three feet is generally loose.

b. Organic Silty Clay – This layer is generally one (1) to six (6) feet in thickness and consists of organic silty clay with layers of peat.

c. Glacial Sand - Below this organic layer is a natural deep glacial sand deposit. From the SPT this layer is generally dense in nature. The top two to three feet of this layer is generally loose.

5.1.3.2 Liquefaction

Liquefaction Analysis has been performed using the Site Specific Seismic Design Criteria developed by the PA to identify liquefiable zones and determine their impact on the design of the structure.

Zones identified as liquefiable will have their capacity reduced to 10% under earthquake loading conditions.

5.1.3.3 Pile Design for Terminal Building, Roadways and Abutments

The use of timber and steel piles has been evaluated for use as the foundation for the terminal and the elevated roadways. The geotechnical data collected from the site during a site investigation, executed as part of the design process, indicates that either timber or steel piles would be suitable given the materials and strata observed.

Downdrag of the upper soils will be applied as appropriate in locations where downdrag is anticipated such as areas affected by liquefaction and areas where fill will be placed.

Axial and lateral capacity of piles will be determined. Axial capacity will be determined by using the DRIVEN software. Lateral capacity will be determined using LPILE and FB_PIER software.

5.1.3.4 Pile Load Testing and Factor of Safety

Load Testing and PDA testing will be employed to confirm the design capacity of the piles.

The factor of safety applied in design will correlate to the anticipated testing. For piles with PDA testing, factor of safety = 2.25. For piles with static load testing, factor of safety = 2.0. For tension conditions without load testing factor of safety of 3.0 will be applied.

6. UTILITIES

6.1 Electrical

6.1.1 Codes, Standards and References

- American National Standards Institute (ANSI)
- Federal Aviation Administration (FAA)
- Illumination Engineering Society of North America: Lighting Handbook.
- Insulated Cable Engineers Association(ICEA)
- Institute of Electrical and Electronic Engineers (IEEE)
- National Electrical Contractors Association (NECA)
- National Electrical Manufacturers Assoc. (NEMA)
- National Fire Protection Assoc.(NFPA)
- National Electric Code (NEC) 2002 with New York Amendments
- National Electric Safety Code
- Occupational Safety and Health Administration (OSHA)
- Underwriters Laboratories (UL) Standard
- PANYNJ Tenant Alteration Procedures and Standards Guide
- PANYNJ Tenant Construction Review Manual
- NYC Building Code

6.1.2 Utility Relocation

Any medium voltage electrical 5kv lines that are in or adjacent to new construction area will be removed or relocated as required.

6.1.3 Medium Voltage Supply System

The electrical load demand of the new terminal building will be serviced by the provision of new sub-stations.

6.1.4 5 kv Duct Banks

The facility will be served by five (5) dedicated incoming supply cables with provision in the duct bank for a sixth serving the terminal, emanating from the Port Authority Central Substation at 4.16KV and enclosed in concrete duct banks.

6.1.5 Roadway Lighting

Arrivals roadway and departures ramp lighting will be designed on the bases of IES recommendations.

The roadway lighting standard will be 30 feet high aluminum pole with 250W HPS, round head type luminaire, rated at 277 volts.

Areas below ascending and descending departure ramps will be lit by ambient light spilling over from the adjacent roadways.

PANYNJ street lighting will be powered from PANYNJ sources. Any JetBlue street lighting will be powered by JetBlue sources

6.2 Storm Drainage

6.2.1 Codes, Standards and References

- FAA AC 150/5320-5B "Airport Drainage"
- Applicable FAA Advisory Circulars
- PANYNJ "Civil Engineering Design Guidelines"
- PANYNJ Tenant Alteration Procedures and Standards Guide
- PANYNJ Tenant Construction Review Manual
- NFPA 415 "Standard on Airport Terminal Buildings, Fueling Ramp Drainage, and Loading Walkways"
- NYS Stormwater Management Design Manual

6.2.2 Scope

Landside and airside design associated with new, relocated or modified storm water drainage systems required to accommodate runoff from the terminal building, arrivals & departures roadways, and airside apron pavement. Roof drainage from the new terminal building will collected into the proposed closed drainage system.

6.2.3 Design Criteria and Assumptions

6.2.3.1 Design Storm

A 10-year storm frequency will be used for designing the system. The final hydraulic grade line will not come within one foot of the catch basin and manhole rim. New and existing storm trunk lines will be interconnected to relieve overloaded conditions. The depressed section of the frontage roadway will be routed to a lift station and will be designed for runoff from a 50-year storm.

6.2.3.2 Storm Drainage in Intersection Areas

Storm drainage for large pavement areas (specifically at intersections with minimum surface cross slopes) will be designed to avoid sheet flow conditions and/or ponding. Series of catch basins may be required to accommodate runoff from the final grading, and will comply with NFPA 415.

6.2.3.3 Storm Drainage at Low Points

Locating two or three catch basins will be placed at low points in areas where high accumulation of debris will be a design challenge. The main catch basin will be placed at the low point and the others on each side, as appropriate. All catch basins will be located a minimum of 100' from the building and be protected with gas-tight vapor traps on the outlet pipe.

The rim elevations of the existing manholes and catch basins, when adjusted to the new grade elevations, will not provide a minimum 2 feet of cover to the existing storm lines.

Design details such as concrete encasements or steel plates will need to be incorporated at these locations. Some portions of the existing storm drainage system on the landside will be relocated and designed by gravity flow to connect into the existing main trunk line on the airside. For some landside areas, use of the lift station will be necessary for the storm drainage system to connect into the airside's gravity system.

6.2.3.4 Apron Drainage

To the greatest extent possible, the existing apron drainage system will be utilized. Where this is not viable, new drainage piping and catch basins will be installed to collect the surface runoff and discharge into the existing system at the nearest practical location. The existing drainage system analysis from the downstream discharge point at Thurston Basin back to the Terminal 5 site (prepared by the Port Authority) will be reviewed and used as the basis of design. Drainage design will be performed in accordance with FAA AC 150/5320-5B "Airport Drainage" and NFPA 415 "Standard on Airport Terminal Buildings, Fueling Ramp Drainage, and Loading Walkways"

6.2.3.5 Lift Station

A lift station will be designed to provide for drainage for the depressed portions of the arrivals and departures roadways that cannot be reconnected to the gravity storm system because of adverse elevation differences of the inverts.

The lift station will be located below grade within the traffic island adjacent to the loading dock area. Above-grade components of the lift station will be minimized and protected from traffic, as necessary. This lift station will have the following design components subject to a complete hydraulic design:

- Provide storage and pumping capacity to convey the runoff of a 50-year storm.
- Provide a duplex lift station structure to accommodate 7,000 GPM (Two 60 HP pump motors which will draw 148 Amps for 230 Volt 3 phase power or 74 Amps of 480 Volt 3 phase power).
- Provide force main pipe connection to gravity drainage system. Connection to be made at manhole structure designed to diffuse excess velocity from the force main discharge, as necessary.
- The lift station will be designed to accommodate AASHTO H-25 traffic loading.
- Provide electrical power service from the pump station to the terminal building. The terminal architect will provide power from terminal building mechanical room.

6.2.3.6 Storm Drainage Pipes

All pipes will be circular, reinforced concrete, Class V, unless otherwise noted on the Schematic Design Drawings. Pipes will be designed to withstand the highest anticipated aircraft or vehicle load.

6.2.3.7 Existing Storm Drainage System

The existing drainage system will be retained, unless otherwise noted on the Schematic Design Drawings. The proposed storm drainage system will connect to the existing main storm trunk lines. All storm drainage pipes will be checked to verify that they can handle existing and proposed peak discharges.

6.2.3.8 Removal and Abandonment of Existing Storm Drainage Pipes

Existing storm drainage pipes will only be removed to accommodate the construction of either the terminal building or other permanent landside/airside facilities.

Existing storm drainage pipes to be abandoned in place will be capped.

6.3 Sanitary Sewer

6.3.1 Codes, Standards and References

- Port Authority Civil Engineering Design Guidelines
- PANYNJ Tenant Alteration Procedures and Standards Guide
- PANYNJ Tenant Construction Review Manual

6.3.2 Scope

Provide the proposed Terminal 5 with sanitary collection services as required.

The PANYNJ will provide a force main for the T5 sanitary discharge to connect to. This force main will be installed and operational prior to the opening of T5

6.3.3 Design criteria and Assumptions

Sanitary sewer lines shall be provided around the terminal building with service connections to locations as designed by the Architect. Sanitary sewer lines shall be designed by gravity from the building services passing through the passageway of the building. It will hug the building outline to the southern end until it crosses to the landside. The sanitary sewer pipe invert elevation will be below the storm drainage pipes when the two system cross. After the crossing, a sanitary lift station will be required to pump the invert elevation to a higher elevation. This will enable the sanitary sewer system to flow by gravity and connect to the existing sanitary sewer system at the manhole southwest of the Saarinen building.

The sanitary sewer line will be designed in conjunction with all other utilities to pass through the pinch point along the arrivals roadway avoiding conflicts with the structural columns for the elevated departures ramp. Sanitary sewer components are as follows:

- Sanitary sewer to be either 8" or 10" RCP or 8" or 10" PVC pipe on a concrete cradle
- Pump chamber to consist of two (2) 250 gpm @ 13 tdh 3 HP 460 volt three phases 60 hertz pumps to provide back-up redundancy
- Chamber to be cast-in-place concrete with electric controls
- Sanitary pump system is to be connected to the Back-up Generator

6.4 Water

6.4.1 Codes, Standards and References

- American Water Works Association (AWWA)
- City of New York Department of Environmental Protection, Bureau of Water Supply and Wastewater Collection
- New York City Building Code

- Underwriters Laboratories Inc. (UL)
- American Society for Testing and Materials (ASTM)
- NFPA 24 Private Fire Service Mains
- PANYNJ Tenant Alteration Procedures and Standards Guide
- PANYNJ Tenant Construction Review Manual
- Port Authority Civil Engineering Design Guidelines

6.4.2 Criteria and Materials

6.4.2.1 Domestic Water Service

Water Service Design

Terminal 5 will be provided with two (2) 4" separate water services, one 4" water line will supply the northwest corner of the terminal and will connect to the existing 24" water line located west of Terminal 5. The other 4" water service will supply the northeast corner of Terminal 5 and will connect to the existing 12" water line located south of Terminal 5, in compliance with NYCBC

All exterior buried domestic water pipes shall be ductile iron pipe, class 52 cement-mortar lined and coated with petroleum asphaltic coating. Ductile iron pipe joints shall be push-on-joints with Snap-Lok restrained joints or mechanical joint pipe. All buried ductile iron pipe shall be encased in a polyethylene encasement. Pipes will be designed to withstand the highest anticipated aircraft or vehicle load

6.4.2.2 Fire Protection Service

Terminal 5 will be provided with two (2) 10" combined fire protection water lines. One 10" combined water line will supply the northwest corner of Terminal 5 and will connect to the existing 24" water line located west of Terminal 5. The other 10" combined water line will supply the northeast corner of Terminal 5 and will connect to the existing 12" water line located south of Terminal 5, in compliance with NYCBC.

Fire hydrants will be installed and located on the landside and airside of Terminal 5, with a maximum spacing of 250 feet and located not less than 40 feet from the Terminal 5. In no case shall any part of the building periphery be more than 300 feet from a hydrant.

All exterior buried fire protection water pipe materials shall be ductile iron pipe, class 56, cement-mortar lined and coated with petroleum asphalt coating. Ductile iron joints shall be push-on-joints with Snap-Lok restrained joints or mechanical joint pipe with Megalug fittings. All buried ductile iron pipe shall be encased in a polyethylene encasement.

6.5 Gas

6.5.1 Codes and Standards

- National Fire Protection Association, NFPA 54 National Fuel Gas Code
- American Gas Association (AGA)
- NYCRR Part 255Transmission & Distribution of Gas
- New York City Building Code
- Underwriters Laboratories Inc. (UL)
- American Society for Testing and Materials (ASTM)
- PANYNJ Tenant Alteration Procedures and Standards Guide
- PANYNJ Tenant Construction Review Manual

6.5.2 Natural Gas Service

Two (2) new 4" high pressure (15psi) gas lines including valves, meters and regulators will be installed to provide natural gas to Terminal 5. One 4" high-pressure gas line will supply the northwest corner of Terminal 5 and will connect to the existing high pressure gas line located west of Terminal 5. The other 4" high pressure gas line will supply the northeast corner of Terminal 5 and will connect to the existing high-pressure gas line located south east of Terminal 5.

Each of the 4" high-pressure gas lines will be designed for the total load of the terminal.

All underground high-pressure piping and fittings shall be ASTM A 106, seamless pipe, Sch 40, Type B, ASME steel welding fittings. All underground piping shall be factory applied protective coating with corrosion-resistant polyethylene coating for use in corrosive atmosphere. All underground coated steel gas piping shall be cathodically protected system to prevent corrosion.

6.6 Communications

6.6.1 Communications Routing and Supply

The program of requirements for the electronic communications system to support the operation of the new terminal is under development.

6.6.2 Communication Duct Relocation

Any communications lines that are in or adjacent to new construction area will be removed or relocated as required.

6.6.3 Traffic Signaling Communication

New duct banks will be provided with 2-3"C to each CTA cabinet. The duct bank shall tap off from nearest communication manhole to the new CTA cabinet.

6.6.4 Traffic Signaling Power

New duct banks will be provided with 2-4"Conduits to each CTA cabinet. The power feeders shall tap off from nearest available PANYNJ 480V power sources to the new CTA cabinet.

6.7 Thermal Distribution System

6.7.1 Codes, Standards and References

- New York City Building Code
- American Society for Testing and Materials (ASTM)
- Energy Conservation Construction Code of New York State
- CALPINE JFK Energy Center Design Manual and Specifications
- PANYNJ Tenant Alteration Procedures and Standards Guide
- PANYNJ Tenant Construction Review Manual

6.7.2 Criteria and Materials

General

Temperatures, pressures, and flows are generated and monitored by the central heating and refrigeration plant (CHRP) for chilled and heating hot water. Hot water from the CHRP is distributed to the terminal buildings through and underground pre-insulated piping loop on the landside. The supply water temperature and pressure are 250°F and 140 PSIG, respectively. And return water temperature and pressure are 170°F and 100 PSIG. Also known as medium temperature water (MTW) generates secondary hot water in each terminal by use of water-to-water plate and frame heat exchangers inside the terminal building. The design pressure for the MTW is 250PSIG.

Chilled water is distributed to the passenger terminals through buried carbon steel underground piping system on the landside. The system generates and pumps chilled water at 45°F at 90 PSIG. The design pressure for chilled water is 150PSIG

For further Design Guidelines and General Provisions, refer to Specifications 15001 and 15010 respectively of Design Manual with Specifications for CALPINE JFK Energy Center.

Related Specifications

15080 - Insulation

15090 - Piping and Equipment Supports, Anchors And Sleeves

15100 - Manual Valves

15910 - Excavation, Trenching, Backfill, Compacting and Conflicts With Existing Utilities

15910 - Temporary Support of Underground Piping

15920 - Procedure For Pile Cap Installation Near Existing MTW Lines

Materials

Underground Medium Temperature Water (MTWS & MTWR)

Piping shall be a pre-insulated type consisting of a carbon steel carrier pipe, polyurethane foam insulation; leak detection alarms wires and an outer jacket of high-density polyethylene (HDPE).

Underground Chilled Water (CHWS & CHWR - New)

Piping shall be pre-insulated cement lined ductile iron pipe.

Underground Steel Chilled Water (CHWS &CHWR - Existing)

Some of the existing underground chilled water piping may be steel pipe. In cases where tie-ins need to be made, new pipe material shall match existing piping.

For further piping materials, jackets, insulations, and fittings, refer to Specification 15105 Pipe And Pipe Fittings.

6.7.2.1 TDS Service (Medium Temperature Water)

Terminal 5 will be provided with two (2) 8" laterals connected to the existing 16" supply main and two (2) 8" lateral return service. The 2 supply mains are sized to handle the full heating load. From the new two 8" laterals, 6" TDS supply and return branches will serve T5. The branch pipes shall have isolation valves and capped 5 feet from building line.

Lateral pipes which connect the loop piping to each terminal, consist of four pipes, two supply and two return. The pipes include isolation valves, which allow either pair to be functional in case of leak in the other set or its associated loop section. Each pair is sized to handle the full heating load of each terminal. Refer to Figure 1 Loop and Lateral Isolation Valve detail in Design Manual with Specifications CALPINE JFK Energy Center. In addition, refer to SK-1, SK-2, and SK-3 for vault details. Vaults are provided with doors for access and covered in Specification 08310 Vault Doors.

The isolation valves shall be fitted with Alstom Bell Ends since the piping may be under water continuously or intermittently. Consult Alstom Power Systems directly for further details. Vent valves shall be fitted with Alstom Bell Ends.

The TDS pre-insulated piping system shall have leak detection wires run throughout its entire length.

6.7.2.2 Chilled Water Service

A new 20" pair chilled water service for Terminal 5 shall be connected to an existing 24" main supply and return. The 20" pair is sized for the full cooling load and shall serve both ends of the terminal by two (2) 14" pair. Each 14" chilled water supply and return will have the same isolation valves and cap design as TDS. Terminate piping 5 feet away from building line.

6.7.2.3 General Criteria for Chilled Water & Hot Water Pipe Sizing (40°F - 250°F)

Pipe Size	GPM Range	Max. Pressure Drop/100' (Water Gauge)	Velocity (FPS)
¾"	0 – 3.0	2.00	1.7
1"	3.1 – 5.5	2.00	2.0
1 ¼"	5.6 – 11.0	2.00	2.4
1 ½"	11.1 – 17.0	2.00	2.7
2"	17.1 – 31.0	2.00	3.0
2 ½"	31.1 – 50.0	2.00	3.5
3"	50.1 – 100.0	2.50	4.5
4"	100.1 – 210.0	2.50	5.4
5"	210.1 – 370.0	2.50	6.2
6"	370.1 – 615.0	2.50	7.5
8"	615.1 – 1200.0	2.00	8.0
10"	1200.1 – 2000.0	1.70	8.0
12"	2000.1 – 2800.0	1.40	8.0
14"	2800.1 – 3400.0	1.25	8.0
16"	3400.1 – 4200.0	1.10	8.0
18"	4200.1 – 5000.0	1.90	8.0
20"	5000.1 – 7000.0	0.80	8.0
24"	7000.1 – 10000.0	0.65	8.0

Table 13 – General criteria for schedule 40 chilled water & hot water pipe sizing (40°F - 250°F). For pipe material which differs from the above, relevant criteria will be provided.

Note: Chilled Water flow-rate shall not exceed 10 fps at design flow.

TDS Design Criteria

When installing new lateral pipes to service new or modified terminals, pipes shall be *sized for a maximum pressure drop of 2 ft. per 100 ft. or a maximum flow rate of 8 fps* with both laterals open.

Chilled Water Design Criteria

New chilled water piping between the primary zones and the metering stations within the terminal (facility) serviced shall be sized for a maximum pressure drop of 2 ft. per 100 ft. and a maximum flow rate of 10 fps at design flow.

All piping shall be specified, installed and tested in accordance with the specification sections in this report or Design Manual of CALPINE JFK Energy Center.

7. BAGGAGE HANDLING SYSTEM

The baggage handling system will be fully integrated into the terminal, allowing for convenient and flexible curbside and ticketing hall take-away of baggage. The overall design of the out bound baggage includes redundant capability, by using belts that are reversible and which can feed bags to the EDS system from either direction from behind the ticketing counter.

The outbound baggage handling system feeds all belts through the EDS room, which is centrally located and which aligns 10 EDS units to allow for greatest throughput capacity and reliability. The outbound belts are all installed directly under and against the Departures Level floor structure, and to the greatest extent possible are run in parallel to allow for a single catwalk to serve two belts and minimize costs. All EDS and ETD equipment is located on ground, at the Arrivals/Apron Level, and structural slabs to support the EDS loads have been accounted for.

The outbound belts after processing through the EDS and ETD spaces again travel overhead, supported directly and immediately adjacent to the Departures Level floor, crossing the concourse tug drive, until they drop into the 10 carousel, baggage make up area.

The Arriving passengers bags are taken by tug to a pair of stripping areas, located under the holdrooms for gates 7 and 8, and 20 and 21, where they are offloaded. The belts travel over the Arrivals Level Operations spaces, again directly on the Departures Level floor, until they drop into one of six Bag Claim Devices, each 180 feet long (the demand analysis requires each claim device to be at least 150', 180 feet is provided in the design).

Detailed analysis of capacity, loads, and design parameters follow.

No provision for Interline baggage is included in the current design.

7.1 Codes, Standards and References

The specifications for the design and installation of the baggage handling systems will require that the Contractor provide adequate safety factors and shall conform to all pertinent standards and codes of the USA, the City of New York, the Port Authority of NY and NJ or the country of design origin, whichever is more stringent.

In the event no specific local codes or standards can be identified, the Contractor will be required to comply with the most recent revision, applicable provisions and recommendations of the following:

- **American Welding Society (AWS)**

D-1.0	Welder Qualifications
AWS-C1.1	Recommended Practice for Resistance Welding in Building Construction
AWS-A2.0	Standard Welding Symbols

Standard welding practice in building construction

- **American Gear Manufacturers Association Standards (AGMA)**

460.04	Practice for Gear Motors
461.01	Practice for Worm Gear Motors

- **American National Standards Institute (ANSI)**

A-12.1	Safety Code for Floor and Wall Openings, Railing, and Toe Boards
B-20.1	Safety Code for Conveyors, Cableways, and Related Equipment
B-20.9	Transmission Roller Chains and Sprocket Teeth
C-33.1	Safety Standard for Flexible Cord and Fixture Wire
Z-53.1	Safety Color Code

- **National Bureau of Standards (NBS)**

Handbook H28	Screw-Thread Standards

- **National Fire Protection Association (NFPA)**

NFPA No. 70	National Electrical Code Volume 2, National Fire Code
NFPA No. 79	Electrical Standards for Industrial Machinery
NFPA No. 80	Standard for Fire Doors and Fire Windows

- **NEC 2002 National Electrical Code**
- **Underwriters Laboratories (UL) (Components must be labeled appropriately)**
- **National Electrical Manufacturers Association Standards (NEMA)**

IC-S	Industrial Controls and Systems
MG-1	Motors and Gear Motors

- **American Society for Testing Materials (ASTM)**

A-36	Structural Steel
A-794	Sheets and Coils - cold rolled
A-569	Sheets & Strip - hot rolled
A-307	Fasteners (Bolts)
A-563	Fasteners (Nuts)
F-844	Fasteners (Washers)

- **American Wood Preservers Association (AWPA)**

C-27	Fire Retardant Wood

All equipment and accessory items furnished and installed under this Contract shall be governed at all times by applicable provisions of federal laws, including but not limited to the revision of the following in effect as of the Contract date:

- **Williams-Steiger Occupational Safety and Health Act (OSHA), of 1970, Public Law 91.596, most current version.**
- **Occupational Safety and Health Administration (OSHA)**

  29 CFR Part 1910 -211 (Definitions)

  29 CFR Part 1910 – 212 (General Industry Standards and Requirements)

  29 CFR Part 1917.48 (Conveyors)

  29 CFR Part 1926.555 (Conveyors, Construction Industry Standards)
- **Office of State Health Planning and Development (OSHPD)**
- **American Society of Mechanical Engineers (ASME)**

  ASME B20.1 - 1996 Safety Standards for Conveyors and Related Equipment, and all Addenda up to and including ASME B20.1a-1997.
- **Conveyor Equipment Manufacturers Association (CEMA)**

ANSI/CEMA 402-1992	Belt Conveyors
ANSI/CEMA B105.1-1992	Specifications for Welded Steel Conveyor Pulleys with Compression-type Hubs

7.2 Scope of Baggage Handling System

7.2.1 Outline Summary of BHS

Check-in

- Four (4) manually-fed ticket counter take-away conveyors; connected at tail ends and reversible for redundancy purposes
- One (1) curbside check-in conveyor with provision for a second (connecting to different ticketing transport conveyors to provide redundancy)
- One (1) oversize conveyor line for conveyable oversize items; terminating with an indexing belt inside a room dedicated to TSA bag search operations on the Apron Level; reversible to facilitate empty baggage tub return. This system will incorporate provision for future expansion.
  (Non-conveyables will be manually transported via elevator to a TSA bag search room)

Sortation & Make-up

- High-speed sortation system (2 main sort lines) located in the Concourse area on the Apron Level
- Two (2) automatic tag readers (laser scanner arrays); one per sort line
- Two (2) manual encoding lines and associated workstations; one per sort line
- Ten (10) flat plate makeup devices/carousels which can accept baggage from each sort line

Claim

- Six (6) slope plate carousels, each fed by one (1) conveyor line with single-sided access at each load/stripping belt
- One (1) oversize claim conveyor line; terminating in the oversize claim area; reversible to facilitate empty baggage tub return
  (Non-conveyables will be manually transported)

Checked Baggage Screening

-
- (Ex. 4)
-
-
-
-

7.2.2 System Description

- *Proposed Processing of Originating Baggage*

The proposed outbound system originates with four (4) manually-fed take-away belt inside the Departures Lobby and two (2) curbside check-in belts. Take-away conveyors behind the ticket counters will be reversible so that bags may be transferred to an adjacent take-away in the event of some downstream failure.

After declining to the level below, these lines (ticketing and curbside) merge together to form four (4) main transport lines (two from each side of the terminal) that run to the in-line screening system located on the Apron Level.

Once cleared through the screening system, bags will continue to a two (2) line sortation system located in the ceiling level of the Concourse area on the Apron Level. In the sortation system, bag tag information will be read by automatic tag readers (360-degree laser scanner arrays) or will immediately be diverted to either of two (2) lines where they can be either hand scanned or manually encoded at dedicated workstations. Based on this

information, bags will be sorted (by flight, destination, etc.) from each sort line to any of the ten (10) flat plate makeup devices/carousels.

Any bags that fail to push to a makeup device will recirculate on a dedicated line back to the beginning of the sort system (a point just upstream of the tag readers).

Oversize:

Two (2) oversize-width conveyor lines (45" between guides) are provided for handling conveyable oversize items (one on each end). The oversize line originating on the North end of the Terminal has one input location adjacent to the ticket counter positions. The oversize line originating on the South end of the Terminal will have input/load points at curbside, along the south wall and directly adjacent to the ticket counters.

Each of these two lines will terminate with an indexing belt located inside a room dedicated to TSA bag search operations on the Apron Level.

An oversize-width conveyor is also provided to transport bags that have been cleared by TSA from this screening room to a dedicated cart/container staging area located just outside this room.

Oversize lines are to be reversible to facilitate empty baggage tub return during non-operational periods as coordinated with TSA (can otherwise be done manually using elevators when required during normal operating hours).

Non-conveyables (e.g., animals, etc.) will be manually transported via elevator to a TSA bag search room.

Checked Baggage Screening:

The baggage handling systems provided for screening all originating checked baggage employ a multi-level process.

Screening Level 1 - Inline EDS Machine

(Ex. 4)

Screening Level 2 – Operator Review

(Ex. 4)

Screening Level 3 – Directed Search using ETD and/or other TSA protocol

(Ex. 4)

Screening Level 4 - LEO and/or other protocol

(Ex. 4)

- Proposed Processing of Terminating Baggage

(Ex. 4)

7.3 Design Criteria and Assumptions

- Baggage Characteristics:

The baggage clearance on all the conveyor lines will be 36" from top of belt to the bottom of the lowest obstruction (e.g., beam, conduit, etc.). The purpose of the 36" bag clearance is to permit the transport of baggage with the following characteristics.

The Baggage Handling System will be designed to convey all user airlines standard baggage tubs and to process baggage having the following characteristics:

Standard Conveyors (39" between guides):

- Max. Weight 120 lbs
- Max. Length 54"
- Max. Height 34"
- Max. Width 33"
- Min. Length 6"
- Min. Height 3"
- Min. Width 3"
- Min. Weight 1 lbs

Oversize Conveyors (45" between guides):

- Max. Weight 150 lbs
- Max. Length 10'
- Max. Height 34"
- Max. Width 39"
- Min. Length 6"
- Min. Height 3"
- Min. Width 3"
- Min. Weight 1 lbs

- **BHS Equipment (Components)**

Transport Conveyor:

Conveyor overall width	3'-6" (standard) 4'-0" (oversize)
Conveyor between-guide width	39" (standard) 45" (oversize)
Conveyor belting width	36" (standard) 42" (oversize)
Conveyor slider bed depth	8" 11" (w/support)
Standard drive depth	1'-3" 1'-6" (w/support)
Max. Standard conveyor length	60'-0" (5 ft. drive) 15'-0" (mini drive)
Min. Standard conveyor length	3'-6" (queue belt)
Nominal angle of incline/decline	15° (non-tracking) 12° (tracking)
Max. angle of incline/decline	18° (non-tracking) 15° (tracking)
Break-over radius	10'-0"
Side guard height (as required for access)	6" to 21"

Power turns and spirals:

Inside radius of turns	4'-0" (standard) 5'-0" (oversize)
Spiral turn rise/drop	12" per 45° of turn (max.)

Incline Plate Carousels:

Conveying surface	5'-0" nominal
Overall width of device	21'-0" minimum
Side guard height (make-up)	1'-0"
Slope of incline plate surface	20 degrees nominal

- Clearances

Required for Conveyor Components and Baggage:

Overhead	3'-0" (measured from top of belt)
Lateral	1'-0" along a wall (or similar broad obstruction) 6" along columns (or similar local obstruction)
Underneath	As required for maintenance access and/or drive aisle clearance

Work Aisles/Positions:

Work aisle width	3'-0"
Work aisle clear height	6'-8" (min.)
Manual Encoding	6'-8" (min.)

Recommended Minimum Drive Aisles (baggage tug and cart):

One-way drive aisle width	15'-0"
Two-way drive aisle width	25'-0"
Bypass aisle	10'-0" (min.)

Cart/Container Staging Lanes:

Parallel to device	7'-0"
Perpendicular to device	15'-0"

- **Elevations (Top of Belt A.F.F.)**

Over drive aisles	9'-6" (to achieve 8' min. clear for tug/cart traffic)
Inbound Load Belts	1'-6"
Outbound Sort Piers	2'-6"
Outbound Make-up	2'-6"

- ***BHS Equipment Functionality***

Conveyor Speeds:

Incline & Flat Plate Devices	90 fpm (make-up or claim)
Load/Unload conveyor	90 fpm (public); 120 fpm (bagroom)
General transport conveyors	120-340 fpm
Max. increase/decrease	30 fpm

High-Speed Sorter:

Throughput rate	60 bpm

Automatic Tag Reader:

Type	360-degree laser scanner array
Primary Tag Type	IATA 10-Digit Bar Code
Back-up Tag	IATA 4-Digit Bar Code

Fire Doors:

Fire rating	FAR Part 107.4 NFPA 2 hour minimum

Maintenance Platforms/Catwalks:

Catwalk width	3'-0" (minimum) 4'-0" (nominal)

- **BHS Equipment Environmental Requirements**

The BHS components will be specified to be designed/engineered to operate satisfactorily in its respective environment as follows.

Note that the following does not include or take into consideration separate requirements for any related non-BHS equipment provided and installed by others (e.g., EDS machines, EDS workstations, ETD equipment, etc.) or personnel which may drive environmental requirements in various areas where BHS equipment also exists.

Mechanical Equipment:

Indoor (Bagroom Environment)
Temperature: 32° to 120° F (0° to 45°C)
Relative Humidity: 5% to 99% Non-condensing
Protected from direct exposure to weather

Outdoor or in Unheated Enclosures
Temperature: -20° to 120° F (-30° to 50°C)
Relative Humidity: 5% to 100% condensing
Covered but not protected from driving rain.

Electrical/Electronic Equipment:

Inside Control Panels
Temperature: 32° to 140° F (0° to 60°C)
Relative Humidity: 5% to 99% Non-condensing

Indoor (Bagroom Environment)
Temperature: 32° to 120° F (0° to 45°C)
Relative Humidity: 5% to 99% Non-condensing
Protected from direct exposure to weather

Outdoor or in Unheated Enclosures
Temperature: -20° to 120° F (-30° to 50°C)
Relative Humidity: 5% to 100% condensing
Covered but not protected from driving rain

Inside Computer/Control Room
Temperature: 55° to 80° Fahrenheit (13° to 27°C)
Relative Humidity: 5% to 50% Non-condensing
Sealed Office Area with Filtered Air Environment

- **BHS Operational Noise Levels**

The BHS components will be specified to be designed/ engineered/fabricated and installed to limit combined equipment and controlled ambient noise levels to the following allowable maximums. In any case, however, the BHS equipment shall not increase the ambient noise level by more than 15 dB(A).

75 dB(A)	In bagroom and all other associated non-public areas or unoccupied areas.
65 dB(A)	In public areas, or ceiling above public areas (measured at a number of positions normally occupied by passengers, public and staff).
45 dB(A)	In adjacent, and/or nearby office areas (measured at the center of the room at a height of 5' above the floor). Further to the specification requirement above, where limiting noise levels is critical and/or where there is a large number / high density of conveyors adjacent/above such office space (or similar type space), it is also advisable to provide acoustical treatments as a part of the building construction (by others).

- BHS Structural Loading

Baggage Conveyors:

The following excerpts will be included in the BHS Technical Specification regarding system design requirements with respect to structural loading criteria. Drawings outlining general BHS structural loading design requirements and typical support assembly methods for the various conveyor components will also be included in the design documentation.

The total load imposed on the building (composed of the conveyor components, supports and baggage) used/assumed for designing structural elements shall be 100 lbs/lin.ft. for standard-width (39" b.g.) conveyor and 120 lbs/lin.ft. for oversize-width (45" b.g.) conveyors.

Standard conveyors shall be 42 inches in overall width and oversize conveyors shall be 48 inches in overall width. Conveyor supports are generally placed on 10-foot centers (each with 2 vertical support rods, or legs in case of floor mounted units) with intermediate supports provided for special conditions such as to support the outside circumference of power turns and shorter components (i.e., drive sections, etc.). These support conditions apply to both ceiling and floor-supported conveyors.

All BHS platforms and catwalks shall be designed to be capable of supporting a minimum dynamic load of 40 pounds per square foot.

Baggage Carts *(for reference only...not part of BHS design)*

Baggage carts have approximately 4,000 lb load capacities and come in essentially two approximate lengths; 10 feet and 16 feet (with tow bar down), weighing up to approximately 1,325 lbs and 1,800 lbs respectively. The width of carts is approximately 4'-6" to 5'-0".

Baggage Containers/Dollies *(for reference only...not part of BHS design)*

The lower deck containers are carried on "dollies" that have approximately 3,500 lb load capacities and are approximately 13'-6" long (with tow bar down) by approximately 6'-0" wide, weighing up to 1,600 to 1,800 lbs depending on model.

- Other Miscellaneous BHS Issues:

Fire/Sprinkler System Interlock Requirements:

The BHS will provide the necessary interlocks/controls at the BHS motor control panel(s) to shut down the related conveyor line(s) and close related fire shutters when an activation signal is received from the fire detection and/or protection systems (to be provided by others). This is in addition to a fusible link which, when broken, will also cause the door to close. The shutdown sequence will be provided with emergency power

Activation of any sprinkler zone associated with the baggage handling system shall initiate shutdown sequence of all baggage handling conveyors in the respective zone. The BHS will be required to provide the necessary I/O interface ports at each of the BHS motor control panels to accommodate the external firematic function.

BHS-Related Ancillary Spaces:

It should be noted that the following types of required BHS ancillary spaces are associated with the system's operation and maintenance.

Since BHS equipment must be located within them, the following are directly related to the BHS design and the location and size of the these rooms/areas will therefore be coordinated during development of the BHS design.

- Motor Control Panel (MCP) areas
- BHS Control Room
- TSA Screening Room(s) for the following:
  - Remote EDS machine operator workstations (subject to verification of requirements/provisions by TSA)
  - Trace detection equipment and related tables (subject to verification of requirements/provisions by TSA)

The following are related to the BHS maintenance operation but, since they do not drive or affect the BHS design, they are presumed to be included in allocation of operational space addressed in other disciplines (i.e., not coordinated with or driven by BHS).

- BHS Spare Parts Room
- BHS Maintenance Room and Tool Area

Spaces within or near to the bagroom area should, of course, also be allocated for the BHS operation, maintenance and TSA staff break rooms, lockers, rest rooms, etc. These are also presumed to be included in allocation of operational space addressed in/by other disciplines (i.e., not coordinated with or driven by BHS).

8. MATERIALS HANDLING

8.1 Loading Dock

The Loading Dock is located on the south side of the terminal processor, and is accessed from the Arrivals Level roadway. Sized for as many as six vehicles, the current layout shows two semi-truck bays and two panel truck/van sized bays, along with two locations for trash compactors. Each of the three sections of the loading dock is approximately 35 feet wide, and four of the bays will be equipped with dock levelers.

The loading dock is approximately 15 feet deep, and although deliveries from the semi trucks are likely to be fewer in number and frequency, the dock can be used for palette breakdown of materials or materials can be directly taken to the interior of the terminal.

Operations spaces for receipt of janitorial supplies and concessions restock are near the loading dock and both are prior to the Arrivals Level security screening, so that further repacking of materials and screening for hand truck deliveries can occur.

(Ex. 4)

8.2 Waste Handling

All trash will be taken to the loading dock, using the service corridor.

9. ARCHITECTURE

9.1 Building Enclosure

In keeping both with its location with respect to the Saarinen designed building and its purpose as a terminal for a low fare airline, the new building will be designed with a low profile and its enclosure will be straight forward and clean in appearance.

The overall façade is intended to be constructed of standardized metal panels and a standing seam roof for the front façade and canopy. All Apron Level airside elevations will be constructed of concrete masonry units.

At the front of the terminal on the Departures Level, a nominal 10' tall glass storefront type wall will be provided, with a series of revolving doors and glass egress doors. In the holdrooms, nominal 6' tall glass windows will allow for views and admit light. At the front of the Arrivals Level, a nominal 10' tall glass storefront type wall will admit light and provide an outward view.

Fixed bridges are designed to be built as part of the overall building construction, and the exterior cladding materials will also be metal panels

Roofing materials will be EPDM for energy performance, protected by roof pavers to allow for regular access to the roof top air handling units. Access to the roof for maintenance will comply with the appropriate code requirements.

9.2 Applicable Codes

The project will be designed to comply with the following codes, regulations, and standards. Where required and applicable code requirements will be listed on the drawings.

- Building, Mechanical, and Plumbing Codes:
  - Building Code of the City of New York, 2004 Edition.
  - Port Authority of NY & NJ, Aviation Department, 'Tenant Alteration Procedures and Standards Guide, March 1998.
  - Port Authority of NY & NJ, Quality Assurance Division, Engineering Department, 'Tenant Construction Review Manual', March 2003.
- Fire: New York City Fire Prevention Code and Directives.
- Laws: New York City Local Laws.
- Rules: Rules of the City of New York, including Title 1 'Department of Buildings', Title 2 'Board of Standards and Appeals (BS&A), Title 3 'Fire Department', and Title 24 'Department of Health'.
- Energy: Energy Conservation Construction Code of New York State.
- Electrical: National Electrical Code with New York City Amendments, latest edition.
- Accessibility: Americans with Disabilities Act (ADA) and ANSI A117.1 (where there is a clash, ADA will govern)
- CALPINE JFK Energy Center Design Manual and Specifications
- Standards:
  - NFPA 415 'Airport Terminal Buildings, Fueling Ramp Drainage, and Loading Walkways', latest edition.
  - NFPA 407, 'Standard for Aircraft Fueling Service', latest edition.
  - FAA Advisory Circular 150/5360.13 "Planning and Design Guidelines for Airport Terminal Facilities".

Site Development

1. **Excavation:** Excavate to all required depths and elevations. Excavation shall include the removal of all existing construction, debris and rubble. Demolition of the existing Terminal 5 FIS (Federal Inspection Service) pile caps to allow for new pile construction. Provide all sheeting, shoring, bracing and underpinning necessary to prevent movement or settlement of existing and new construction, utilities, walks, or paving. Provide pumping and draining as necessary to keep the excavation and construction operations free of water. Dewatering systems during excavation operations may be required. Excavated material will be reused on site, any remaining excess material will be removed from the site.

2. **Paving and Site Lighting.**

a. **Airside Ramp (Apron) Pavements:** Portland cement concrete (PCC) and / or asphalt flexible pavement
b. **Landside Vehicular Roadways:** Cast-in-place concrete and precast concrete planks at the structured Departures Level roadway; balance of landside vehicular roadways asphalt flexible pavement.
c. **Landside Non-Vehicular Exterior Sidewalks:** Cast –in-place concrete.
d. **Curbs & Gutters:** Cast –in-place concrete.
e. **Landside Roadway Barrier Wall:** Architectural cast-in-place concrete.
f. **Site Lighting:** Recessed wall and overhead post mounted types at landside roadside barrier walls. Downlighting at canopies over exterior sidewalks at landside departure and arrival levels. Fixtures will be required to illuminate the airside areas of the ramp (apron).

3. **Site Utilities:** As required to meet project specific requirements for drainage, fire and domestic water supply, gas, electric, other utilities, storm and sanitary sewerage requirements.

Structural Systems

1. **Foundations:** Pile foundation system, with cast-in-place concrete caps.
2. **Superstructure:** Fireproofed steel framing with concrete filled floor, and unfilled roof, metal decking typically. Cast in place concrete topped precast plank framing of exterior Departures Level roadway deck.

9.3 Building Enclosure

9.3.1 TERMINAL AND AIRTRAIN CONNECTOR

9.3.1.1 Walls Above Grade:

- Cladding System Types: Matt finish metal and glass cladding systems, and ground face concrete masonry unit (CMU) wall on the airside apron level. Each wall above grade will be designed as a system that will resist positive and negative wind loads, air infiltration and water penetration while accommodating building movements and environmental requirements of the building's mechanical and electrical services. Two separate and distinct lines of defense against water penetration and air infiltration will be required for all walls above grade. All systems are to be provided with auxiliary means to collect and discharge penetrating moisture and condensation.

Cladding System Materials:

a. **Sheathing and Insulation:** The sheathing and insulation will be supported by and attached to structural steel and cold formed metal stud framing. The sheathing will be attached to the exterior side of the framing and be composed of glass mat faced exterior gypsum sheathing boards with silicone joint sealants. The sheathing will be covered with a continuous air barrier membrane system which will be in turn be covered by a single layer of 2" thick rigid polystyrene board insulation and metal panel furring strips. A single 3" thick layer of flexible batt mineral fiber (rock wool) insulation with foil faced vapor barrier will be applied to the interior side of the sheathing between the cold formed metal stud framing 2" thick rigid mineral fiber (rock wool) insulation with foil faced vapor barrier applied to the *structural decks at soffits.*

b. **Ground Face CMU Cladding:** Single wythe, reinforced, ground face CMU's fabricated with integral water repellent additives in one color and texture will be required. The CMU's, and galvanized steel shelf angles for the CMU's cladding support at door, louver, and window openings in the wall, shall be tied or connected to the building's structural frame and may be used to provide anchorage for doors, windows, and louvers. All expansion joints in the ground face CMU wall system to be sealed with a two lines of silicone sealant.

c. **Windows Wall and Framing Systems:** All framing for windows and curtain walls, will be fabricated from thermally broken aluminum extrusions. The window and curtain wall framing systems shall be unitized and capable of being reglazed from the inside. The finish for all interior exposed facets of the aluminum framing will be clear anodized aluminum, the finish for all exterior facets (mullion caps) of the aluminum framing will be a two (2) coat non-micaflake fluorocarbon resinous coating.

1. Window Wall Framing: All window wall framing will either be attached to cold formed metal framing or the building's structural frame.

2. Glass and Glazing:

a) Typical Insulating Units: Typical insulating glass units will be 1" thick and be composed of a ¼" thick clear glass outboard light with a low emissivity coated second surface, a ½" hermetically sealed air gap, and a 1/4" thick clear glass inboard light, heat treated as required by code to sustain wind loads and resist temperature stress breakage Aluminum air gap spacers to be black colored.

1) Alternative: For the provision of acoustical insulating glass units having an overall thickness of 1-5/16", and composed of a ¼" thick clear glass outboard light with a low emissivity coated second surface, a ½" hermetically sealed air gap, and a 9/16" thick clear glass inboard light, heat treated as required by code to sustain wind loads and resist temperature stress breakage.

b) Clerestory Light Monitor Insulating Glass Units: Glass units will be 1-5/16" thick, and composed of a clear outboard light with a low emissivity coated second surface, a ½" hermetically sealed air gap, and a 9/16" thick clear glass inboard light with a 0.060" thick pvb film interlayer, heat treated as required by code to sustain wind loads and resist temperature stress breakage. The film interlayer at the south, east and west elevations will be white, the interlayer for the north elevation will be clear.

c) All vertical glazing joints within the window, curtain wall, and storefront systems will be 2 side vertical structural glazed with silicone sealants.

e. **Door Entrances:** 14'-0" diameter, motorized, extruded aluminum framed, revolving doors

g. **Canopies:** Custom fabricated, metal framed, and solid panel canopies finished to match window and curtain wall.

h. **Metal Panels:** Custom fabricated light or dark grey, panels with exposed fasteners. Panels may be furnished with formed flashing at window head, sill and panel corners.

i. **Soffit Panels:** Custom fabricated panels with stiffeners and heli-arc welded corners. finish to match window and curtain wall.

1. Soffit panels hung with galvanized steel supports. Insulation installed to underside of structural deck above.

j. **Flashing Systems:** Continuous sheet metal flashing.

k. **Exterior Wall Interior Side Finish:** *Steel studs supporting painted gypsum wallboard.*

l. **Window Treatment:** All exterior windows and curtain walls are assumed to be furnished without window treatment.

m. **Loading Dock and Make-Up Area Baggage Room Door Entrances:** Overhead rolling doors with flush steel, uninsulated narrow slats, power operated; field painted to match window and curtain wall.

n. **Exterior Stairs at Aprons (Ramps):** Galvanized steel construction. Risers to be perforated sheet metal, treads and nosings to be diamond checkered slip resistant textured grey iron castings, guardrails to be rectangular wire mesh infill retained in channel steel framing.

9.3.1.2 **Walls and Slabs Below Grade:**

a. **Typical:** 2" thick extruded polystyrene slab on grade insulation at all turned down slab edges of the building perimeter.

b. **Walls and Slabs Below Grade:** Reinforced concrete walls with positive side, protected, hot fluid applied waterproofing. Protected, hot fluid applied waterproofing system with integral flashing transitions to adjacent vertical waterproofing systems over mud mat slabs will be required at depressed slabs below grade.

9.3.1.3 **Roofing Systems:**

a. **Flat Roofs:**

- All flat roof systems will incorporate a minimum of 1/8 inch per foot slope for drainage.

    1. Drop Off Decks: Protected, waterproofing system with integral flashing transitions to continuous architectural expansion joints and trench drain systems will be required at the concrete topped, precast plank framed, structural decks of the exterior departures level roadway deck.

    2. Typical Roofs: White, non-reinforced, EPDM membrane with heat welded seams fully adhered to mechanically fastened polyisocyanurate insulation board over glass mat faced gypsum sheathing protected unfilled metal deck. Flat roofs will be supplemented with continuous flashing and counterflashing around perimeters and penetrations. Copings will be formed from metal flashing matching corrugated metal panel material.

        1. Alternative: For the provision of thermoplastic membrane comprised of a reinforced, white color pigmented, PVC in lieu of a white, non-reinforced EPDM membrane.

b. **Sloped Roofs:** Standing seam, ventilated, sheet metal roofing system. Sheet metal roofing panels will be fastened to vertical hat shaped furring strips over roofing felt over preservative treated ¾" thick plywood roof sheathing over 2x wood blocking bolted to, or through, roof decking. Rigid, extruded polystyrene roof insulation boards will be placed between furring strips directly over the roofing felt covered decks. Ridge and eave edge conditions will be detailed to accommodate venting. Metal roofs will be supplemented with ice and water shield underlayment lined continuous sheet metal gutters, flashing and counter flashing around perimeters and penetrations. No sheet metal work shall have a sealant or mastic as the primary method of waterproofing. The sheet metal materials being considered for the metal roofing may be zinc, coated in a contrasting color, to the zinc sheets used in the fabrication of the corrugated metal panels.

9.3.1.4 **Outline of Performance Criteria:**

Design Wind Pressure: Per the Building Code for the City of New York.

Seismic Requirements: Per the TCRM

Glass Statistical Factor:

Vertical Glass: 8 lights in 1,000.

Thermal Movement:

Aluminum and Metal Components: Withstand expansion and contraction forces over a surface temperature range of -5 degrees F. to +180 degrees F.

Deflection (At Full Loading) for Cold Formed Metal Framing:

Normal to plane of wall at full loading; no less than 1/400 of the clear span of the component part.

Deflections (At full loading) for Windows, Curtain Walls and Storefront:

Normal to plane of wall at full loading; 1/175 or ¾" whichever is less, of the clear span of the component part, except limit center point deflection of glass for exterior and interior walls to 1" and ½" respectively; limit deflection of horizontal glass supporting members to 1/300 of glass length.

Deflection parallel to wall plane not to exceed 75% of glass edge clearance, and shall not reduce edge clearance to less than 25% of design dimension or 1/8" whichever is greater.

Design Factor of Safety (Windows, Curtain Walls and Storefronts): All structural components (i.e. members, glazing stops or gaskets); 1.5 times maximum Design Wind Pressure when tested in accordance with ASTM E330.

Leakage of Air (Windows, Curtain Walls, and Storefronts): Not greater than 0.06 CFM per sq. ft. on a complete module, exclusive of doors, when tested under a pressure of 6.25 psf per ASTM E283.

Leakage of Water (Windows, Curtain Walls, and Storefronts): No infiltration of water when tested at 12 psf pressure in accordance with ASTM E331.

Building Movements: As determined by adjacent surfaces.

The minimum head height available in the arrivals level will be 7.5'

The minimum head height available in the departures level will be 7.5'

General Description of Interior Architectural Finishes

9.3.2 TERMINAL AND AIR TRAIN CONNECTOR

9.3.2.1 Arrivals Level

All demising walls that separate landside from airside functions will be a hardwall assembly composed of a full height, to underside of structure, non-reinforced concrete masonry unit single wythe partition clad on both sides with full height painted gypsum wallboard over furring strips.

a. **Baggage Claim and Arrival Hall:**

1. **Floors:** Thinset epoxy terrazzo over isolation membrane.

a) Alternative: For the provision of a monolithic shake on concrete floor topping in lieu of thinset terrazzo over isolation membrane.

2. **Walls:** Aluminum framing systems retaining clear monolithic safety glass on airlock vestibule elevation; particleboard core wall paneling at the back wall elevations of baggage claim.

3. **Ceilings:** Indirect hung, 100% accessible, torsion spring attached, perforated painted aluminum metal pan ceiling system, with acoustic batts in sealed acoustically transparent plastic bags.

a) Alternative: For the provision of direct hung, 100% accessible, painted metal baffle ceiling system in lieu of metal pan ceiling system

4. **Accessories:** Steel columns at carousel areas to be clad with glass fiber reinforced gypsum column covers. Concrete columns to be painted.

b. **Airlock Vestibules to Baggage Claim:**

1. **Floors:** Standard recessed walk-off mat fabricated from extruded aluminum shapes with extrusions designed to retain replaceable carpet strips.

2. **Walls:** Storefront type aluminum framing systems retaining insulated safety *glass on exterior wall elevation and clear monolithic safety glass on baggage* claim elevation.

3. **Ceilings:** Indirect hung, 100% accessible, torsion spring attached, perforated painted aluminum metal pans.

c. **Baggage Claim Public Bathrooms and Vestibules:**

1. **Floors:** ceramic tile, thinset.

2. **Walls:** *Combination of ceramic tile thinset, and painted finish; ceramic tile* cove base.

3. **Ceilings:** Indirect hung, 100% accessible, torsion spring attached, perforated painted aluminum metal pan ceiling system.

4. **Bathroom Partitions:** Ceiling hung, high-density polyethylene (HDPE) panel with homogenous color and pattern throughout thickness of material.

5. **Vanities:** Custom, trough shaped, vanity fabricated from nominal ¾" thick solid surfacing material.

d. **Back of House Service Corridors:**

1. **Floors:** Vinyl composition tile.

2. **Walls:** Painted gypsum wallboard. Painted, surface applied, 48" high continuous diamond plate steel wall protection.

3. **Ceilings:** Painted gypsum wallboard.

e. **Skycap Area, Ops, People Department, Facility Maintenance, Concession Admin., Customer Services, Corp. Security, Provisions, Security/Inbound Freight, Customer Services (Supply & Mailroom):**

1. **Floors:** Carpeting. Vinyl composition tile at Skycap Area only.

2. **Walls:** Painted gypsum wallboard. Vinyl resilient base.

3. **Ceilings:** Acoustic ceiling panels on an indirect hung exposed grid system.

f. **IT:**

1. **Floors:** Static dissipative vinyl composition tile.

2. **Walls:** Painted gypsum wallboard. Vinyl resilient base.

3. **Ceilings:** Acoustic ceiling panels on an indirect hung exposed grid system.

g. **Janitorial/Cabin Cleaning, RAM Services, MEP Rooms, Facility Maintenance *(Shops & Storage), Cabin Cleaning/Storage:***

1. **Floors:** Exposed concrete floors, sealed.

2. **Walls:** Painted gypsum wallboard.

3. **Ceiling:** Exposed structure.

h. **Flight Ops/Crew Services/In-flight Services, Checkpoint Security:**

1. **Floors:** Carpeting in lounge and office function spaces.

2. **Walls:** Painted gypsum wallboard. Vinyl resilient base.

3. **Ceilings:** Acoustic ceiling panels on an indirect hung exposed grid system.

i. **Concession Storage:**

1. **Floors:** Exposed concrete floors, sealed.

2. **Walls:** Painted gypsum wallboard.

3. **Ceilings:** Exposed structure.

4. **Accessories:** Storage compartments made from wire fabric retained in welded steel channel framing.

j. **Ramp Services, Materials Services, Ramp Services/Fueling:**

1. **Floors:** Carpeting or vinyl tile in office function spaces. Sealed exposed concrete floors in workshop areas.

2. **Walls:** Painted gypsum wallboard and vinyl resilient base in office function spaces. Painted gypsum wallboard in workshop areas.

3. **Ceilings:** Acoustic ceiling panels on an indirect hung exposed grid system in office areas. Ceilings to be exposed structure in workshop areas.

k. **Aircraft Maintenance/Quality Control/Tech Standards/Aircraft Business Partners:**

1. **Floors:** Carpeting or vinyl tile in office function spaces. Sealed exposed concrete floors in workshop and storage areas.

2. **Walls:** Painted gypsum wallboard and vinyl resilient base in office function spaces. Painted gypsum wallboard in workshop and storage areas.

3. **Ceilings:** Acoustic ceiling panels on an indirect hung exposed grid system in office areas. Ceilings to be exposed structure in workshop and storage areas.

l. **Loading Dock:**

1. **Floors:** Vinyl composition tile at dock master office. Sealed exposed concrete floors typical.

2. **Walls:** Painted concrete masonry units.

3. **Ceilings:** Rigid insulation applied to underside of deck above.

4. **Accessories:** Dock levelers and dock bumpers at each bay. 1 garbage compactor and one recycling bin with capacities to be determined through design development. Non-insulated overhead rolling steel doors.

m. **Baggage Inspection Areas:**

1. **Floors:** Carpet or vinyl tile and rubber floor mat.

2. **Walls:** Combination of stainless steel clad formed metal acoustical panels, and painted gypsum wallboard.

3. **Ceilings:** Combination of suspended acoustical panel ceilings and painted gypsum board bulkheads.

n. **EDS/Baggage Systems Rooms:**

1. **Floors:** Exposed concrete floors, sealed.

2. **Walls:** Painted gypsum wallboard.

3. **Ceilings:** Rigid insulation applied to underside of deck above.

o. **Make-Up Area Baggage Rooms:**

1. **Floors:** Exposed concrete floors, sealed.

2. **Walls:** Painted, reinforced concrete masonry units.

3. **Ceilings:** Rigid insulation applied to underside of deck above.

4. **Accessories:** Medium density fireproofing to exposed steel vertical framing members. Concrete filled steel bollards at ends of baggage carousels as a minimum, non-insulated overhead rolling steel doors.

p. **Egress Exit Stairs:**

1. **Stairs:** Concrete filled metal pan.

2. **Walls:** Painted gypsum wallboard shaftwall.

3. **Soffits and Ceilings:** Exposed structure.

4. **Railings:** Painted steel railings with wire mesh infill panels.

9.3.2.2 Departures/Concourse Level

a. **Check-In Hall Area:**

1. **Floors:** Thinset epoxy terrazzo floor over isolation membrane.

a) Alternative: For the provision of a monolithic shake on concrete floor topping in lieu of thinset terrazzo over isolation membrane.

2. **Walls:** Aluminum framing systems retaining clear monolithic safety glass on airlock vestibule elevation; plastic laminate veneered particleboard core wall paneling at the back wall elevations of check in hall areas. 8" high, precast epoxy terrazzo base at columns.

a) Alternative for Wall Paneling: For the provision of solid composite panels in lieu of plastic laminate veneered particleboard core wall paneling

b) Alternative for Column Bases: For the provision of an 8" high satin finished stainless steel clad aluminum base in lieu of precast terrazzo base.

3. **Ceilings:** Indirect hung, 100% accessible, torsion spring attached, perforated painted aluminum metal pan ceiling system, with acoustic batts in sealed acoustically transparent plastic bags.

a) Alternative: For the provision of direct hung, 100% accessible, painted metal baffle ceiling system in lieu of metal pan ceiling system

4. **Accessories:** Steel columns at to be clad with glass fiber reinforced gypsum column covers. EDS equipment to be provided and installed by TSA. Ticketing counters to be fabricated of built-in architectural woodwork clad with satin finished stainless steel and solid composite paneling.

b. **Restrooms:**

- The restrooms will comply with the requirements of the Port Authorities Tenant Construction Review Manual.

1. **Floors:** ceramic tile, thinset.

2. **Walls:** Combination of painted finish and ceramic tile thinset to gypsum wallboard; ceramic tile cove base.

3. **Ceilings:** Indirect hung, 100% accessible, torsion spring attached, perforated painted aluminum metal pan ceiling system.

4. **Bathroom Partitions:** Ceiling hung, high-density polyethylene (HDPE) panel with homogenous color and pattern throughout thickness of material

5. **Vanities:** Custom, trough shaped, vanity fabricated from nominal ¾" thick solid surfacing material.

6. **Accessories:** Brushed stainless steel. Frameless mirrors.

c. **Skycap Area, ATO, Checkpoint Security, Flight Ops, and Service Corridors:**

1. **Floors:** Carpet or vinyl tile.

2. **Walls:** Painted gypsum wallboard. Vinyl resilient base.

3. **Ceilings:** Acoustic ceiling panels on an indirect hung exposed grid system.

d. **Electrical Closets, Retail Closets, Gas, Customer Services/Facility Maintenance (Storage), Provisions Service Vestibule:**

1. **Floors:** Exposed concrete floors, sealed.

2. **Walls:** Painted gypsum wallboard. Painted concrete masonry unit walls at provisions/loading dock.

3. **Ceiling:** Exposed structure.

e. **Concessions Areas:**

1. **Floors:** Exposed concrete floors, sealed. Slabs not to be depressed. Fitout by tenant.

2. **Walls:** Taped, floated and sanded gypsum wallboard extending to underside of structural deck ready to receive finish by tenant.

3. **Ceilings:** Exposed structure, ready to receive tenant ceiling.

f. **Food Court 'Market Plaza':** Design Standards will be developed for implementation by the Concessionaire(s).

1. **Floors:** Thinset epoxy terrazzo floor over isolation membrane.

a) Alternative: For the provision of a monolithic shake on concrete floor topping in lieu of thinset terrazzo over isolation membrane.

2. **Walls:** Not applicable.

3. **Ceilings:** Acoustical, perforated, painted, metal roof decking.

g. **Main Circulation Corridors from Food Court to Passenger Waiting Areas:**

1. **Floors:** Thinset epoxy terrazzo floor over isolation membrane.

a) Alternative: For the provision of a monolithic shake on concrete floor topping in lieu of thinset terrazzo over isolation membrane.

2. **Walls:** Combination of materials with a highly durable and maintainable finishes.

3. **Ceilings:** Indirect hung, painted gypsum board or metal panel.

h. **Main Circulation Corridors from Food Court to Passenger Waiting Areas:**

1. **Floors:** Thinset epoxy terrazzo floor over isolation membrane.

a) Alternative: For the provision of a monolithic shake on concrete floor topping in lieu of thinset terrazzo over isolation membrane.

2. **Walls:** Combination of materials with a highly durable and maintainable finishes.

3. **Ceilings:** Indirect hung, painted gypsum board or metal panel. Aluminum framed 'Panelite' light baffles at skylight/clerestory's. Skylight/clerestory bulkheads closed off with perforated painted metal panels.

i. **Passenger Waiting Areas (Hold Rooms):**

1. **Floors:** Carpet.

2. **Walls:** Exterior wall windows

3. **Ceilings:** acoustic ceiling planks on an indirect hung exposed grid system.

4. **Accessories:** BIDS, FIDS, and counters to be fabricated of built-in architectural woodwork clad with satin finished stainless steel and solid composite paneling. Defibrilators and fire extinguisher cabinets.

k. **Public Stairs:**

1. **Stairs:** Thinset precast epoxy terrazzo treads and risers supported by metal pan stair framing.

2. **Walls:** Painted gypsum wallboard shaftwall.

3. **Soffits and Ceilings:** Painted gypsum wallboard bulkheads.

4. **Railings:** Combination of satin finished stainless steel handrails with vertical posts and horizontal top rail with a satin finished stainless steel capped tempered structural glass guardrail located immediately behind the handrail.

9.3.2.3 **AirTrain Connector**

a. **Connector Bridge:**

1. **Floors:** Thinset epoxy terrazzo over isolation membrane.

2. **Walls:** Exterior glass and metal panels.

3. **Ceilings:** Painted gypsum wallboard bulkheads and metal, stud framed and supported ceiling system, with acoustic batts in sealed acoustically transparent plastic bags.

b. **Ramp Control Tower:**

1. **Floors:** Carpet. Thinset ceramic tile in toilet room.

2. **Walls:** Exterior curtain walls and painted gypsum board. Vinyl resilient base typical, ceramic tile base in toilet room.

3. **Ceilings:** Acoustic ceiling panels on an indirect hung exposed grid system.

4. **Accessories:** Plastic laminate veneered built-in architectural woodwork.

10. TERMINAL BUILDING ENGINEERING

10.1 Structural

10.1.1 Codes, Standards and Reference

- Building Code of the City of New York 2004
- AASHTO Sixteenth Edition with 1999 Interim Revisions
- PANYNJ Tenant Construction Review Manual, March 2003
- American Concrete Institute Building Code Requirements for Reinforced Concrete ACI 318-89
- American Institute for Steel Construction, ASD 9th Edition
- Steel Joist Institute Standard Specification for Joists and Joist Girders w/1994 Revisions

10.1.2 Structural Systems

Vehicular access to the departures and arrivals curbs is uncontrolled. The exterior terminal structure adjacent to these locations has been selected to be capable of limiting damage to localized areas as a result of an external detonation of an explosive device concealed in a vehicle. This analysis has not considered a specific type or size threat and was not based on limiting damage to a specific minimum area.

Vibration analysis will be considered during the design

10.1.2.1 Departures Roadway

The portion of the departures roadway immediately in front of the central processor will function as an integral portion of the building structure. In addition to support of departures level traffic, this structure will function as the roof of the baggage claim hall below.

The roadway is predominantly circular in plan. The elevated roadway deck has been designed to be jointless construction for the length of the building, to eliminate water infiltration. Expansion joints are provided at interface of the roadway with the access road structures and at the connection between the departures roadway and a possible future extension of the structure. A curved expansion joint separates the roadway structure from the remainder of the building.

(Ex. 4)

(Ex. 4)

Design Loads

(Ex. 4)

10.1.2.2 Central Processor

The processor Arrivals level floor will typically be structured with a two-way flat slab spanning between pile caps. Grade beams will be provided at the perimeter of the slab, at slab elevation changes and below CMU partition walls.

Building heights in the processor area vary from approximately 35' at the entrance curtainwall to approximately 65' at the roof high point above the marketplace.

(Ex. 4)

Design Loads

(Ex. 4)

10.1.2.3 Y Shaped Concourses

(Ex. 4)

10.1.3 Live Load Deflection Criteria

(Ex. 4)

10.1.4 Lateral Load Deflection Criteria

(Ex. 4)

10.1.5 Materials

(Ex. 4)

Design Loads

(Ex. 4)

10.1.2.4 AirTrain Connector Bridge

10.2 Mechanical

10.2.1 Building Codes And Standards

The Codes and Standards to be used in the design of this project are as follows:

- Building Code of the City of New York and associated reference standards
- New York State Energy Conservation Construction Code
- New York City Air Pollution Regulations
- New York City Board of Standards and Appeals (Rules of)
- New York State Fire Prevention and Building Code
- NFPA 415 - Construction and Protection of Airport Terminal Buildings
- PANYNJ Tenant Construction Review Manual
- CALPINE JFK Energy Center Design Manual and Specifications
- Relevant ASHRAE, ASME, ANSI, API and NFPA Standards will also be used.
- NYC fire prevention code.

10.2.2 Design Criteria

The information given in this section is a summary of the criteria and strategies being used in developing the system design. Further detailed information will be provided as appropriate with TAA design submittals.

The building will be designed to meet the requirements of the New York State Energy Conservation Construction Code (listed in section 10.2.1)

10.2.2.1 Weather Conditions

External design conditions used for the sizing of building mechanical systems will be as given in the ASHRAE Fundamentals handbook, 2001 edition, for:

City: JFK Airport, New York, NY, USA

Latitude: 40.65 degrees

Longitude: 73.78 degrees

Elevation: approximately 23 feet

Summer			
Design dry bulb	88°F	Design wet bulb	75°F
Mean coincident wet bulb	72°F	Mean coincident dry bulb	84°F
Enthalpy at 88°F/72°F	35.7 Btu/lb	Enthalpy at 84°F/75°F	38.6 Btu/lb
Winter			
Design dry bulb	11°F/5°F		

Table 14 – External design conditions

Summer figures quoted above represent conditions that are exceeded for 1.0% of the year or conversely 99% of the year, conditions are lower than this temperature (dry bulb and coincident wet bulb). Winter figures represent temperature from ASHRAE that are exceeded for 99% of the year. This means that if all other building cooling or heating loads are present during these hours the system will be overloaded and building temperature will rise or fall by a small amount depending on the season.

The winter value (11°F) quoted above is also taken from ASHRAE, although 5°F winter design temperature is mandated by the NYC Building Code.

From the summer table it can be seen that the greatest outside air enthalpy is 38.6 Btu/lb. This will be used where relevant in the design.

Any impact that anticipated global warming may have on climatic conditions at the site is not being accounted for in the design.

10.2.2.2 *Indoor Design Temperature and Humidity*

The temperature tolerances noted represent the coincident variation of temperatures in a single space or zone. The temperature listed is the setpoint temperature. The tolerance is not the deadband associated with the setpoint.

Area	Summer Temperature (deg F)	Winter Temperature (deg F)	Summer Humidity (%RH)	Winter Humidity (%RH)
Arrivals Level				
Level 1				
Baggage Claim	74±3	74±3	Note 1	Note 1
Concession Admin	74±2	72±2	Note 1	Note 1
Customer Service	74±2	72±2	Note 1	Note 1
Cabin Cleaning	74±2	72±2	Note 1	Note 1
Flight Ops	74±2	72±2	Note 1	Note 1
Ramp Services	74±2	72±2	Note 1	Note 1
JFK Ops	74±2	72±2	Note 1	Note 1
EDS	74±3	74±3	Note 1	Note 1
Concession Storage	74±2	72±2	Note 1	Note 1
Facility Maint. Offices	74±2	72±2	Note 1	Note 1
Facility Maint. Workshop	74±3	72±3	Note 1	Note 1
Facility Maint. Storage	74±2	72±2	Note 1	Note 1
Security	74±2	72±2	Note 1	Note 1
Restrooms	75±4	75±4	Note 1	Note 1
Loading Dock	Vented only	65±5	Note 1	NA
Oxygen Rm.	TBD	TBD	Note 1	Note 1
Oil Room	TBD	TBD	Note 1	Note 1
Stair	NA	Min. 55	Note 1	Note 1
MEP	Vented only	60- 85	Note 1	NA
Baggage Control Rm.	74±2	72±2	Note 1	Note 1
Corridor	74±4	74±4	Note 1	Note 1
Trash Room	Vent only	Min 55	NA	NA
Manual Encoding	Note 2	Note 2	Note 2	Note 2
Outbound Bag Stripping	Note 3	Note 3	Note 3	Note 3
Main Comms Rm.	72±2	72±2	50±5%	50±5%

Area	Summer Temperature (deg F)	Winter Temperature (deg F)	Summer Humidity (%RH)	Winter Humidity (%RH)
Misc. Comms Closets	74±4	74±4	Note 1	Note 1
Inbound Bag Road	Note 6	Note 6	Note 6	Note 6
Departures Level Level 2				
Landside Check In	74±3	74±3	Note 1	Note 1
Passenger Screening	74±3	74±3	Note 1	Note 1
Concessions	74±3	74±3	Note 1	Note 1
Marketplace	74±3	74±3	Note 1	Note 1
Restrooms	75±4	75±4	Note 1	Note 1
Hold Rooms	74±3	74±3	Note 1	Note 1
Concourse Circulation	74±3	74±3	Note 1	Note 1
ATO	74±2	72±2	Note 1	Note 1
Stair	NA	Min. 55	NA	Note 1
MEP	Vented only	60- 85	Note 1	NA
Fixed Jet Bridges	Note 4	Min. 65	Note 1	Note 1
Ramp Control Tower	72±2	72±2	Note 1	Note 1
Air Train Connector	74±3	74±3	Note 1	Note 1
Flight Wing - New	74±3	74±3	Note 1	Note 1
Flight Wing - Existing	Note 5	Note 5	Note 1	Note 1

Table 15 – Indoor design temperature and humidity

Notes:

1. Winter humidification to be provided only for main communications room(s). Spaces not controlled (all others) will have a relative humidity which will vary depending on external conditions and could go as low as 15% RH in winter. The summer indoor relative humidity will be controlled to not exceed a 65% RH.
2. A dedicated heating and cooling zone will be provided for the manual encoding position. Due to the open nature of this space and the current state of the design of this area we have not yet determined an achievable criteria. We will advise the Owner regarding this as the design develops.
3. No summer cooling is provided (ventilation and air movement only). Winter heating will be provided to heat to max 65degrees, wind conditions have not been included for this area. Refer to Section 10.2.8.6 for further details. No winter or summer humidity control is provided.
4. Refer to Section 10.2.8.10 for full details.
5. Refer to Section 10.2.8.13 for full details.
6. No summer cooling is provided (ventilation and air movement only). Winter heating will be provided to heat to max 65dgerees, wind conditions have not been included for this area. Refer to Section 10.2.8.5 for further details. No winter or summer humidity control is provided.
7. The design of the building will comply with the requirements of the New York State Energy Conservation Construction Code as referenced in 10.2.1.

10.2.2.3 Occupancy

Area	Occupant Density (ft^2/person u.o.n.) - estimated	Notes
Arrivals Level Level 1		
Baggage Claim	20	
Concession Admin	100	
Customer Service	100	
Cabin Cleaning	100	
Flight Ops	100	
Ramp Services	100	
JFK Ops	100	
EDS	200	
Concession Storage	Unoccupied	
Facility Maint. Offices	100	
Facility Maint. Workshop	200	
Facility Maint. Storage	Unoccupied	
Security Inbound	100	
Restrooms	100	
Loading Dock	200	
Oxygen Rm.	Unoccupied	
Oil Room	Unoccupied	
Stair	Unoccupied	
MEP	Unoccupied	
Baggage Control Rm.	3 people	
Manual Encoding	2 people	
Outbound Bag Stripping	N/A	
Main Comms Rm.	11 people	
Misc. Comms Closet	Unoccupied	

Departures Level Level 2		
Landside Check In	4 to 100	Note 2
Passenger Screening	100	
Concessions	25	
Marketplace	10 - 50	Note 3
Restrooms	100	
Hold Rooms	15	
Concourse Circulation	100	
ATO	4 to 100	Note 2
Stair	Unoccupied	
MEP	Unoccupied	
Fixed Jet Bridges	NA	
Ramp Control Tower	8 People	
Air Train Connector	140 People	
Flight Wing - New	20 People	
Flight Wing - Existing	20 People	

Table 16 – Occupancy

Notes:
1. The values above will be used to determine heating, cooling and ventilation requirements for the spaces listed. The peak building simultaneous occupancy will be 7,000 people. The central systems (chilled water, heating hot water, etc.) will be-sized using this number.
2. The occupancy loading factors for the landside ticketing vary from 4 sf/person in ticket queuing areas to 100 sf/person in the circulation areas. For the purpose of design 35 sf/person was used as the average occupancy for this area.
3. The marketplace is comprised of circulation space and seating areas. ASHRAE 62-1999 was used for occupancy loads for these types of areas, 10 sf/person and 50 sf/person respectively. These were averaged together and 23 sf/person was used for the load calculations.

10.2.2.4 Outside Air

Outside air will be supplied to the continuously occupied areas in accordance with ASHRAE Standard 62-1999 and standard industry practices, as follows:

Area	Min. Outside Air (cfm per person unless noted)	Source
Arrivals Level		
Baggage Claim	15	ASHRAE 62-1999
Concession Admin	20	ASHRAE 62-1999
Customer Service	20	ASHRAE 62-1999
Cabin Cleaning	20	ASHRAE 62-1999
Flight Ops	20	ASHRAE 62-1999
Ramp Services	20	ASHRAE 62-1999
JFK Ops	20	ASHRAE 62-1999
EDS	20	Estimate
Concession Storage	NA	Estimate
Facility Maint. Offices	20	ASHRAE 62-1999/Arup Est.
Facility Maint. Workshop	6 ACH^{-1}	Estimate
Facility Maint. Storage	NA	Estimate
Security	20	ASHRAE 62-1999
Restrooms	50 cfm/w.c.	ASHRAE 62-1999
Loading Dock	6 ACH^{-1}	ASHRAE 62-1999
Oxygen Rm.	TBD	Note 4
Oil Room	TBD	Note 4
Stair	NA	NYCBC
MEP	0.05 cfm/sf	Estimate
Baggage Control Rm.	20	Estimate
Manual Encoding	20	Estimate
Outbound Bag Stripping	N/A	Note 3
Main Comms Rm.	20	ASHRAE 62-1999
Misc. Comms Closets	N/A	-
Departures Level		
Landside Check In	15	ASHRAE 62-1999
Passenger Screening	15	ASHRAE 62-1999
Concessions	15	ASHRAE 62-1999
Marketplace	15	ASHRAE 62-1999
Restrooms	50 cfm/w.c.	ASHRAE 62-1999
Hold Rooms	15	ASHRAE 62-1999
Concourse Circulation	15	Estimate

Area	Min. Outside Air (cfm per person unless noted)	Source
ATO	20	ASHRAE 62-1999
Stair	NA	Estimate
MEP	0.05 cfm/sf	Estimate
Fixed Jet Bridges	N/A	ASHRAE 62-1999
Ramp Control Rower	20	ASHRAE 62-1999
Air Train Connector	15	ASHRAE 62-1999
Flight Wing - New	15	ASHRAE 62-1999
Flight Wing – Existing	15	ASHRAE 62-1999

Table 17 – Outside Air

Notes:

1. Air handling units will automatically vary the outside air quantity based on carbon dioxide levels measured in the return air stream.
2. All air handling units will have the capability of introducing 100% outside air (economizer cycle).
3. Space to be exhausted mechanically at 1.0 cfm/sf or greater and a similar amount of make up air provided.
4. Program usage and resulting code classification have yet to be determined.

10.2.2.5 Heat Gains to Air Conditioned Spaces

Area	Lighting load (W/sf)	Equipment load (W/sf)	Occupant sensible heat (Btu/ person)	Occupants latent heat (Btu/person)
Arrivals Level				
Baggage Claim	1.3	1.5	250	250
Concession Admin	1.5	2	250	200
Customer Service	1.5	2	250	200
Cabin Cleaning	1.5	2	250	200
Flight Ops	1.5	2	250	200
Ramp Services	1.5	2	250	200
JFK Ops	1.5	2	250	200
EDS	1.5	Note 2	250	200
Concession Storage	1.0	2	NA	NA
Facility Maint. Offices	1.5	2	250	200
Facility Maint. Workshop	2	3	300	260
Facility Maint. Storage	1.0	0.5	NA	NA
Security Inbound	1.5	3	250	200
Restrooms	1.0	0	250	200
Loading Dock	2	2	250	250
Oxygen Rm.	1.5	2	NA	NA
Oil Room	1.5	2	NA	NA
Stair	1.5	0	NA	NA
MEP	1.0	Note 1	NA	NA
Baggage Control Rm.	1.2	Note 2	250	200
Manual Encoding	1.2	Note 2	250	250
Outbound Bag Stripping	1.0	Note 2	300	275
Main Comms Rm.	1.5	7	250	200
Misc. Comms Closets	1.0	Note 1	NA	NA
Departures Level				
Landside Check In	0.7	0.3	250	250
Passenger Screening	1.8	4	250	250
Concessions	1.6 - 3.9	10	275	275
Marketplace	1.5	Note 3	275	275
Restrooms	1.0	0	250	200
Hold Rooms	1.0	0.5	250	250
Concourse Circulation	0.7	Note 4	250	250
ATO	1.8	3	250	200
Stair	1.5	0	NA	NA
MEP	1.0	Note 1	NA	NA
Fixed Jet Bridges	0.7	Note 1	250	250
Ramp Control Tower	1.5	0	250	250
Air Train Connector	0.7	5.0	250	250
Flight Wing – New	0.7	0	250	250
Flight Wing – Existing	NA	NA	NA	NA

Table 18 – Heat gains to air conditioned spaces

Sources: the information in the above table is a combination of design team estimates and:

1. New York State Energy Code Table 805A.2 Interior Lighting Power
2. KONE People Mover
3. ASHRAE Fundamentals 2001 29.4 Table 1 Occupant Heat Gains.

Notes:

1. Detailed MEP space loads will be calculated as the design develops.
2. These loads are not shown on the above table. The loads indicated above are the estimated plug loads which occur in addition to the baggage loads.
3. Internal loads for the market place were estimated based on 340 people eating hot meals assumed to be 10W sensible and 10W latent per meal. Additionally, 1 W/sf was allocated for kiosks and video displays.
4. 6,000W were used for every two hold rooms to provide an allowance for twelve video monitors at 500W each for flight information. This is approximately 1 W/sf.
5. The lighting load was estimated at 1.2 W/sf as the building average load.

10.2.2.6 Infiltration

Area	Infiltration Rate (ach^{-1})	Source
Arrivals Level		
Baggage Claim	0.5	Estimate
Concession Admin	0.3	Estimate/ASHRAE
Customer Service	0.3	Estimate/ASHRAE
Cabin Cleaning	0.3	Estimate/ASHRAE
Flight Ops	0	Estimate
Ramp Services	0.3	Estimate/ASHRAE
JFK Ops	0	Estimate
EDS	0.3	Estimate/ASHRAE
Concession Storage	0.3	Estimate
Facility Maint. Offices	0	Estimate
Facility Maint. Workshop	0	Estimate
Facility Maint. Storage	0.3	Estimate/ASHRAE
Security	0.3	Estimate/ASHRAE
Restrooms	0	Estimate
Loading Dock	2.0	Estimate
Oxygen Rm.	0.3	Estimate/ASHRAE
Oil Room	0.3	Estimate/ASHRAE
Stair	0.3	Estimate/ASHRAE
MEP	0.3	Estimate/ASHRAE
Baggage Control Rm.	0.5	Estimate
Manual Encoding	0.5	Estimate
Outbound Bag Stripping	1	Estimate
Main Comms Rm.	0	Estimate
Misc. Comms Closets	0	Estimate
Departures Level		
Landside Check In	0.5	Estimate
Passenger Screening	0	Estimate
Concessions	0.3	Estimate
Marketplace	0.1	Estimate
Restrooms	0.3	Estimate/ASHRAE
Hold Rooms	0.3	Estimate/ASHRAE
Concourse Circulation	0.1	Estimate
ATO	0	Estimate
Stair	0.3	Estimate/ASHRAE
MEP	0.3	Estimate/ASHRAE
Fixed Jet Bridges	0.5	Estimate
Ramp Control Tower	0.3	Estimate/ASHRAE
Air Train Connector	0.3	Estimate/ASHRAE
Flight Wing - New	0.3	Estimate/ASHRAE

Table 19 – Infiltration

Notes:

1. The building will be positively pressurized to minimize infiltration of unconditioned outside air. However, as the success of this approach cannot be guaranteed under all operating circumstances, an allowance is being made in the heating and cooling load calculations for infiltration loads.
2. Infiltration rate used only in calculating heating and cooling loads in perimeter spaces.
3. ASHRAE values taken from FUNDAMENTALS 2001, Chap. 26.24 for average wall construction.

10.2.2.7 Filtration and Air Quality

The strategy proposed is to include particulate filters in all air handling systems and to provide space in the air handling systems serving continuously occupied, enclosed, indoor spaces to allow the installation of gas phase filters in the future as needed.

Area	Prefilter Efficiency (ASHRAE 52/76)	Final Filter Efficiency (ASHRAE 52/76)	Gas Phase Filtration	Comments
Arrivals Level				
Baggage Claim	30%	85%	Note 1	
Concession Admin	30%	85%	Note 1	
Customer Service	30%	85%	Note 1	
Cabin Cleaning	30%	85%	Note 1	
Flight Ops	30%	85%	Note 1	
Ramp Services	30%	85%	Note 1	
JFK Ops	30%	85%	Note 1	
EDS	30%	85%	Note 1	
Concession Storage	30%	85%	Note 1	
Facility Maint. Offices	30%	85%	Note 1	
Facility Maint. Workshop	30%	85%	Note 1	
Facility Maint. Storage	30%	85%	Note 1	
Security	30%	85%	Note 1	
Restrooms	30%	85%	Note 1	
Loading Dock	30%	N/A	Note 1	
Oxygen Rm.	30%	85%	TBD	Note 3
Oil Room	30%	85%	TBD	Note 3
MEP	40%	N/A	TBD	Note 3
Baggage Control Rm.	30%	85%	Note 1	
Manual Encoding	30%	85%	Note 1	
Outbound Bag Stripping	N/A	N/A	Note 1	
Main Comms Rm.	30%	95%	Note 1	
Misc. Comms Closets	30%	N/A	Note 1	See Section 10.2.8.8
Inbound Bag Road	Varies	Varies	NA	Note 4
Departures Level				
Landside Check In	30%	85%	Note 1	
Passenger Screening	30%	85%	Note 1	
Concessions	30%	85%	Note 1	
Marketplace	30%	85%	Note 1	
Restrooms	30%	85%	Note 1	
Hold Rooms	30%	85%	Note 1	
Concourse Circulation	30%	85%	Note 1	
ATO	30%	85%	Note 1	
Stair	N/A	N/A	Note 1	
MEP	30%	N/A	Note 1	
Fixed Jet Bridges	N/A	N/A	Note 1	
Ramp Control Tower	30%	85%	Note 1	
Air Train Connector	30%	85%	Note 1	
Connector – New	30%	85%	Note 1	
Connector – Existing	Note 2	Note 2	Note 2	

Table 20 – Filtration and air quality

Notes:

1. Space will be left in all air handling units for cartridge-type carbon filters to be installed by the Owner if required.
2. To be verified.
3. Air distribution system to be determined
4. The make up air comes from two source: the EDS area which receives filtration as noted and directly from the exterior which is unfiltered.

10.2.2.8 Equipment Background Noise Levels

Mechanical equipment will be designed to produce the following target maximum noise levels:

Area	Background noise due to mechanical equipment (NC levels)
Arrivals Level	
Baggage Claim	45-50
Concession Admin	35-40
Customer Service	35-40
Concessions	40-45
Cabin Cleaning	35-40
Flight Ops	35-40
Ramp Services	35-40
JFK Ops	35-40

Area	Background noise due to mechanical equipment (NC levels)
EDS (Unoccupied Area)	-
EDS (Occupied Area)	35-40
Concession Storage	-
Facility Maintenance Offices	35-40
Facility Maintenance Workshop	40-45
Facility Maintenance Storage	-
Security	40-45
Restrooms	40-45
Loading Dock	-
Oxygen Rm.	-
Oil Room	-
Stair	45-50
MEP	65
Baggage Control Room	35-40
Manual Encoding	45-50
Outbound Bag Stripping	45-50
Main Comms Room	35-40
Misc. Comms Closets	-
Inbound Bag Road	-
Training Room	35-40
Conference Room	35-40
Break Room	35-40
Locker Room	35-40
Departures Level	
Landside Check In	45-50
Passenger Screening	40-45
Concessions	40-45
Marketplace	40-45
Restrooms	40-45
Hold Rooms	40-45
Concourse Circulation	40-45
ATO	40-45
Stair	45-50
MEP	65
Fixed Jet Bridges	40-45
Ramp Control Tower	35-40
Air Train Connector	40-45
Flight Wing - New	40-45

Table 21 – Mechanical Noise Levels

10.2.3 Heating And Cooling Load Calculations

10.2.3.1 Additional Criteria

Solar and Fabric Gains:

The U valves for the walls, windows, roofs, slab and skylights were calculated based on preliminary design information. Additional required U values were taken from the 2002 New York State Energy Conservation Construction Code for a commercial building in New York City with between 40% and 50% glazed wall area. These include:

U wall = 0.091 Btu/h·sf·°F

U window = 0.50 Btu/h·sf·°F

SC window = 0.34

U roof = 0.053 Btu/h·sf·°F

U skylight = 0.8 Btu/h·sf·°F

U slab = no requirement

For the solar load calculations, no internal shading devices were used and a medium colored building was assumed with a light colored roof.

Piping Heat Gains and Losses:

No allowance has been made for piping losses at present. As the design progresses and the mechanical plant is laid out, calculations into heat loss will be completed. The pipe insulation shall comply with the NY State Energy Code.

Duct Heat Gains:

Supply ductwork form the air handling units to the spaces served were assumed to have 2°F of duct heat gain from the surrounding plenums, shafts and spaces. Duct and plenum insulation shall comply with the New York State Energy Code section 803.2.8.

Diversity Factors:

Diversity factors are percentage reductions to the maximum values for a given criteria based on knowledge that not all the assumed value will be present at any given moment.

Occupancy:

The individual occupancies for all spaces summed totals over 12,000 people. The programming of the terminal is for at most 7,000 people will be present in the building which occurs during shift 1. The individual spaces will also have fluctuations in population which have not be taken into account at this point. Only the overall occupancy has been used to diversify the total occupant and resulting ventilation load.

Lighting Loads:

The lighting power levels are assumed to occur at full levels during peak occupied times and thus no diversity was taken. No allowance for natural day lighting was assumed at this point in the design.

Plug Loads:

The miscellaneous power loads on the space are based on estimates and need to be verified as the design progresses. No diversity has been assumed to occur at peak times.

Baggage Belts:

The total baggage belt load for the building is 2426 hp. This number is assumed to have a diversity of 80% of this value occurring at most occupied times. Additionally, another 10% was assumed to be spare motor capacity which since not loaded is a further reduction to the full value used in calculations.

10.2.4 Cooling Systems

Cooling media for the facility will be chilled water (CHW) distributed to the terminal from the central Calpine plant. CHW piping will enter the headhouse at a single location and will be valved and metered at entry to the building. Separate Calpine and JetBlue meters will be provided in series.

The following system characteristics information was received from Calpine:

Pressure leaving in the central utility plant (CUP) is approximately 60 psi but can get as high as 100 psi under certain operating conditions.

Pressure returning to the CUP is approximately 40 psi but can get as high as 80 psi under certain operating conditions.

Supply temperature leaving the CUP gets as high as 45°F. It can be as low as 41°F. There is no significant temperature gain in the site distribution piping and the maximum temperature at the building entry can be taken to be 45°F also.

The typical temperature delta T (difference between supply temperature and return temperature) is 10°F but this can get as high as 15°F. There is no requirement for users to specifically control the delta T achieved within their buildings although it should be kept as high as possible.

There are days (one or two periods of a few days) in winter when chilled water is shut down or the temperature rises significantly above 45°F. Otherwise, 45°F is held except under extreme climatic conditions or machine failure.

Chilled water is available all winter except as noted above.

There does not need to be physical separation between the Calpine chilled water system and the building system, i.e., no heat exchangers are needed

The Calpine energy meter in the JetBlue building will be a Controlotron 10/10 meter. It does not need to be in a separate room but will be in its own case/cage.

Water quality management and degeneration are to be carried out at the CUP.

10.2.4.1 Essential Winter Cooling Systems

All systems are cooled from air handling units located on the roof of the building or in Level 1. These units have economizers and can provide cooling in winter.

This approach to winter cooling is not appropriate for all spaces with winter cooling loads. Refer to Section 10.2.8.7 for details of air conditioning in the main communications rooms. To date, we have not determined a need for essential chilled water-based winter cooling in any other spaces. However, as the design develops it may be determined that other spaces require essential chilled water cooling, such as: elevator machine rooms, comms closets, lighting control rooms, etc. Should this need develop, a dedicated air cooled chiller may be added to the design.

10.2.5 Heating Systems

Heating media for the facility will be medium temperature hot water (MTHW) distributed to the terminal from the Calpine plant. Low temperature hot water (HHW) will be generated via plate heat exchangers inside the building and distributed to the heating equipment throughout the terminal (see below).

MTHW pipings will enter the building at a single location. The connection will be valved and metered at entry to the building. Separate Calpine and JetBlue meters will be provided in series.

The following system characteristics information was received from Calpine:

- Pressure leaving the CUP can be 110 psi. Pressure returning to the CUP can be 80 psi.
- Temperature of supply is 250°F minimum but can get to 280°F. In summer the temperature drops to 150°F.
- Calpine requires their district heating loop to be separated from the building's heating system by heat exchangers – minimum of two per building. Alfa Laval plate-and-frame heat are the required type.

Primary consumption will be controlled by the cogeneration facility.

10.2.5.1 Secondary Heating System

Secondary heating hot water (HHW) will be generated by plate heat exchangers from 10.2.5.3 above. It will be a mixture of water and glycol to prevent freezing.

HHW will be distributed to air handling unit heating coils, fancoil units, unit heaters, perimeter radiation, etc. The HHW flow rate will be varied using variable speed drive pumps and pressure controls.

10.2.5.2 Gas Heating

Low intensity gas-fired radiant heating in the outbound bag stripping areas.

10.2.6 Humidification System

Only the main communications room will be humidified. Humidification for the main communication room will be provided by the humidifiers built into the Computer Room Air Conditioning units proposed for use. The architectural envelope containing by the communication room will require a continuous vapor barrier.

10.2.7 Fresh Air Intake and Exhaust

Fresh air intakes will be located at or above roof line to minimize the quantities of external pollutants drawn into the building's air conditioning system.

Exhaust air points will be located in accordance with code requirements. Where possible exhaust air will be used to provide incidental, secondary cooling to non-air-conditioned, occupied areas, such as baggage stripping rooms.

A minimum separation of 25 feet will be maintained between ventilation intake and exhaust points.

10.2.8 Air Handling Systems

10.2.8.1 General

The primary method of HVAC in the new terminal employs roof-mounted air handing units. Each unit consists of a return fan, outside air intake, mixing box, filter section, glycol heating coil, cooling coil and plenum fan. This configuration and the rooftop location permits the units to have 100% outside air economizer mode whenever the ambient weather conditions are suitable to cool the interior loads.

10.2.8.2 Public Spaces

These spaces will be provided with all-air, HVAC systems primarily using rooftop air handling units (AHU) with some indoor AHUs. These spaces are sub-divided in HVAC zones: each zone is heated and cooled by a dedicated rooftop unit. Temperature control of the supply air is done at the air handling unit by the units heating and cooling coils. These units will have variable frequency/speed drives for the supply and return fans. They will operate as VAV systems with a limited turndown capability (to maintain air balance and distribution).

Fully partitioned spaces, such as for concessions, it will require VAV boxes for zone temperature control.

10.2.8.3 Back of House Occupied Spaces

These spaces will be provided with all-air, HVAC systems primarily using rooftop air handling units (AHU). These spaces are sub-divided in HVAC zones: each zone is heated and cooled by a dedicated rooftop unit. Temperature control of the supply air is done at the air handling unit by the units heating and cooling coils. These units will have variable frequency/speed drives for the supply and return fans. They will operate as VAV systems with a limited turndown capability (to maintain air balance and distribution).

10.2.8.4 EDS Area

Dedicated rooftop air handling units will serve this area.. VAV boxes with terminal reheat will be used.

Some of the supply air will be returned to the air handling units. The remainder will be:

supplied via over-pressurization and leakage and transfer fans to the Inbound Bag Roadway as make-up for its exhaust systems. Refer to Section 10.2.8.5

used to pressurize the bag control room and the manual encoding station in an attempt to maintain environmental control in these spaces

10.2.8.5 Inbound Baggage Roadway

Heating and ventilation only are to be provided. Heating will be provided by the use of air curtains at the tug doors and hot water unit heaters located as close as possible to the bag penetrations leading into the building. Exhaust will be provided at a rate of 1.5 cfm/sf using perimeter fans discharging through a louver band located 10'-0" above apron level. At least 50% of the exhaust air will be taken from within 0'-6" of the floor. Make-up air will be provided from a combination of sources: the EDS area as described above and also directly from outside via the louver band. Fans will be provided to give increased summertime air movement under the control of the occupants. Air curtains will be provided at openings where the baggage system enters open areas.

10.2.8.6 Outbound Bag Stripping Areas

Heating and ventilation only are to be provided. Heating will be provided by either:

- low intensity gas-fired radiant heating, and/or,
- hot water unit heaters

Exhaust will be provided at a rate of 1.5 cfm/sf using perimeter fans discharging through a louver band located 10'-0" above apron level. At least 50% of the exhaust air will be taken from within 0'-6" of the floor.

Make-up air will be provided via the louver band and via the doors when open. Fans will be provided to give increased summertime air movement under the control of the occupants.

10.2.8.7 Main Communications Rooms

The primary HVAC system will be dedicated Computer Room Air Conditioning Units (CRAC) providing filtration, heating, cooling, dehumidification and humidification as necessary. Ventilation air will be provided via a rooftop air handler dedicated VAV box. Multiple CRAC units will be provided to include at least 30% standby/redundancy of equipment.

These units will have two sources of cooling: building chilled water via a chilled water coil; and DX-cooling (each unit will have its own integral refrigeration circuit) with heat rejection via a glycol loop to a dry-air cooler located on the roof. If there are two main communications rooms then two glycol loops and dry air coolers will be used.

10.2.8.8 Communications Closets

Closets will be cooled by the use of transfer fans pulling air from the surrounding spaces through these rooms and exhausting air into the RA path.

10.2.8.9 Concessions

The space allocated for the concessions fit out has been factored into the loading of the HVAC system Space for exhaust fans on the roof has been allocated.

Kitchen hood exhaust hood have been planned for in the design, to minimize the disruption to the ceiling plenum during tenant construction

10.2.8.10 Fixed Links

The fixed links connecting the loading bridges will be heated using transfer air from the concourse for occupant comfort and to prevent sprinkler freeze-up.

As the fixed links are between the main concourse and the aircraft loading bridges (ALB) they will receive transfer air from the concourses via the ALB pressurization fans. Consequently, in summer the temperature in these spaces will be above the concourse air temperature.

10.2.8.11 AirTrain Connector

The energy required for the conditioning of the connector will be supplied by the AirTrain system (similar to other CTA stations). Air conditioning will be underfloor dedicated air handling units.

10.2.8.12 West Tube connector to Original T5 – New

The existing tube to be retained is currently serviced from the existing Saarinen building. The tube will be connected to new services from the new T5 building.

10.2.8.13 Tube connector to Original T5 – Existing

Currently this is served by an air handling system in the existing T-5. No upgrade is planned as part of this project..

10.2.8.14 Ramp Control Tower

The ramp control tower will be serviced as part of the main terminal building.

10.2.8.15 Tenant Capped Services

Chilled water and heating hot water capped services will be made available for tenants, business partners or other users.

10.2.9 System Redundancy And Standby Provisions

The following system redundancy and standby provisions are being made:

1. Calpine heating and cooling energy sources will be provided via a radial system thereby providing only one connection to the terminal building.
2. The heating system is, in general, being designed with two of each major system components (heat exchangers and pumps) each sized at 70% of the total building load.
3. The chilled water system is being designed with two main chilled water pumps, each sized at 100%, with a bypass.
4. Spaces with critical environmental requirements will be provided with redundancy of air handling up to 30%. Currently only central communications rooms are seen to have this requirement which will be satisfied by an excess number of in-room computer air conditioning units ("Liebert" type).
5. Air conditioning systems will not be on emergency power (with the exception of the central communications room air conditioning equipment). Air handling unit fans will be supplied by the emergency power system as they will be used for smoke purge.
6. Controls systems redundancy will be provided only by the use of networked stand alone DDC outstations.

10.2.10 Miscellaneous Extract Systems

All extract systems will terminate at a perimeter wall or above the roof, with the exhaust fan at downstream end.

10.2.10.1 Bathrooms

All toilets will be exhausted at the code mandated rate per water closet/urinal. A minimum 75 cfm/water closet will be provided in all bathrooms. Janitor's Closets will typically be exhausted using bathroom systems.

10.2.10.2 Battery Charging and Oxygen/Oil rooms

Dedicated extract systems will be provided.

10.2.10.3 Workshops

Dedicated extract systems will be provided.

10.2.10.4 General Exhaust

General exhaust will be provided for spaces/functions as appropriate, including: locker rooms, trash storage, raingear room, etc.

10.2.11 Smoke Purge

The following requirements of the NYC Building Code are being used as the basis of design:

- All smoke purge air/smoke will be discharged through/above the roof
- Normal ventilation systems will be used for smoke purge
- Smoke purge will be an emergency power function (see Section 10.3 Electrical)
- Engineered "active" smoke control is not required.

In general, the return/exhaust section of the air handling system serving an area will be sized to provide a minimum of 6 ach^{-1}. Supplemental smoke purge fans will provide additional purge if required.

10.2.12 Pre-Conditioned Air to Aircraft

All aircraft pre-conditioned air will be provided by packaged, distributed units local to the aircraft bridges.

10.2.13 Aircraft Loading Walkway Pressurization

NFPA 415 and PA standards combine to require that aircraft loading bridges (ALB) be pressurized by dedicated fans, operating whenever an aircraft is docked at the gate, and drawing pressurizing air from an uncontaminated source.

(Ex. 4)

10.2.14 Building Occupancy Classifications

The mechanical systems will be designed in accordance with standard Occupancy Classifications

10.3 Electrical

10.3.1 Building Codes and Standards

1. New York City Electrical Code – NEC 2002 with amendments
2. Building Code of the City of New York and associated reference standards
3. New York State Energy Conservation and Construction Code
4. Americans with Disabilities Act
5. PANYNJ Tenant Construction Review manual
6. NFPA 415 – Construction and Protection of Airport Terminal Buildings
7. National Fire Protection Association
8. National Electric Safety Code
9. Occupancy Safety and Health Administration
10. National Electrical Contractors Association
11. National Electrical Manufacturer Association
12. Underwriters Laboratories Standards
13. Illumination Engineering Society of North America Reference Standards
14. Institute of Electrical and Electronic Engineers Reference Standards
15. FAA advisory circulars for airports
16. PANYNJ Tenant Alteration Procedures and Standards Guide

10.3.2 Design Criteria

The information given in this section is a summary of the criteria and strategies being used in developing the system design. The information will need to be refined as the design progresses and more specific information becomes available

The power requirements for the terminal Headhouse and Concourse will be based on the design criteria indicated in table below.

NOTES (for table opposite):
1. Future expansion is not included in this load estimation.
2. Existing and new loads in the existing T5 Terminal will be served by the existing electrical infrastructure.
3. Due to the large power requirement for baggage handling system and the gates, the preliminary load estimate has indicated that a total of (3) substations are required for the entire terminal
4. Each substation will be configured for a 'spot' network type electrical system I.e. (5) transformers connected in parallel to a common bus.
5. 500kCMIL feeders will be used for 5kV distribution as instructed by PA.
6. Pass. Loading Bridge does not operate when GP is energized.

ELECTRICAL LOAD COMPUTATIONS (PRELIMINARY)

JFK JetBlue Terminal - Overall
Area = 665981 sq.ft.

Load Type	Floor Sq. Ft	Ltg VA/sq. ft	Ltg KVA	Power VA/sq. ft	Power KVA	Conn. KVA	Dem (%)	Demand KVA
						NORMAL KVA		
1. Light & Power								
a. Light(excluding item 1c)	603359	1.5	905.04			905	1.00	905.04
b. Power(excluding item 1d)	603359			1.5	905.04	905	0.80	724.03
c. Retail (Level 1,2) – Power&Light						793	0.85	674.05
e. Tickeling counter (52 stations, 20 Kiosks)					72.00	72	0.80	57.60
Sub Total								2361
2. IT						150	0.80	120
3. HVAC (Demand Load)						3307	1.00	3307
4. PLUMBING						50	0.80	40
a. Eye wash water heater (for emergency use)						432	0.1	43
b. Toilet Water heater (outdoor)						16	0.2	3
5. Elevators (9 @ 15hp each)						139	0.70	98
6. Escalators (6 @ 20hp each)						124	1.00	124
7. Power Walk-way (7 @ 50 hp each)						361	1.00	361
Sub Total								4096
8. Baggage Handling System(BHS) - 2200HP						2716	0.80	2172
d. EDS, ETS Security Scanner						390	0.80	312
Sub Total								2484
9. Jetway System - 30 Tons								
a. Ground power 400HZ (26 @ 90 kVA per gate)						2340	0.80	1872
b. Pass Loading Bridges (26 @ 31 kVA per gate)						805	0	0
c. Pre-Conditioning Air (26 @ 68 kVA per gate)						1768	0.80	1414
Sub Total								3286
10. Exterior Loads								
a. Stormwater Pump						124	1.00	124
b. Sewage Pump						3	1.00	3
c. Hydrant Fueling System						58	1.00	58
d. Cathodic Protection						46	1.00	46
e. Battery Chargers						120	1.00	120
Sub Total								351
						TOTAL	kVA	12579
TOTAL DESIGN LOAD (kVA)						1.25	D.F.	10063

10.3.3 Electrical Service

- The electrical load demand of the HeadHouse and Concourse buildings will be serviced by new substations.

10.3.3.1 Incoming medium voltage Supply Cables

(Ex. 4)

10.3.4 Sub-station Equipment

(Ex. 4)

10.3.5 Low Voltage Distribution

(Ex. 4)

10.3.6 Emergency Supply System.

(Ex. 4)

10.3.6.1 Emergency Supply Room Equipment

(Ex. 4)

10.3.6.2 Emergency Load

Distribution of Life safety and Essential loads is as follows:

Type of load	
Life Safety Loads (LSL)	Connected Load (kVA)
Fire alarm system	10
Smoke purge	1120
Fire pumps	207
Egress lighting/Exit Signs	334
Elec/Mech rooms lighting	10
Elevators for handicap egress	46
Security systems (Access to egress)	30
Fire Door and associated conveyors and Security doors	282
Subtotal	2039
Essential Loads	Connected Load (kVA)
Building Management System	10
Public Address	10
IT Main Room	150
Flight Information System	20
Ramp Tower Control	10
HVAC system	150
Ticketing counters/Kiosks	36
IT Air Conditioning	30
Apron Ltg.	30
Stormwater Pump	124
Exterior Sewage Pump	3
Building Sewage Ejector Pump	29
Subtotal	602

Table 23 – Distribution of Life Safety Loads

10.3.7 Ground Power System:

Distributed converter system with static rectifier and 30-ton preconditioned air will be provided for each gate. The converter, pre-conditioned air and bridge will be rated at 480 volts, 3-phase and power requirements are as follows:

- 90 kVA 400 HZ converter for each aircraft gate
- 68 kVA service for each Pre Conditioned Air
- 31 kVA Amps service for each bridge

10.3.8 Receptacle Power:

The following is a guideline for the provision of duplex receptacles.

- Convenient and dedicated surge protective computer receptacles in office areas.
- Ground fault circuit interrupter receptacles for toilets, wet locations and below grade spaces.
- Cleaning equipment receptacles in corridors, public areas, ramps, connectors, bridges and lobbies.
- Maintenance tool receptacles in equipment rooms (Electrical, Mechanical, Communication and Telephone rooms).
- GFI receptacles will be provided at all damp and wet locations

10.3.9 Tenant Power

Power for tenants will be derived from the retail area electrical closets and the supply feeders will be terminated in the fused disconnect switches. The switches will be located in the tenant's space. The electronic retail revenue metering system, which consists of local electronic sub-meters and central computer, will be provided to monitor the power usage of the tenants for billing purposes. The local electronic sub-meters will be located in the retail electrical closets. The following are the general requirements for particular occupants:

Federal Agencies	One 480V/277V, 3 Phase, 4 wire feeder terminated in a 200 amps fused disconnect switch.
Restaurant/Fast food	One 208/120V, 3-Phase and one 480/277V, 3- Phase, 4-wire feeders, terminated in a 200 amps fused disconnect switches.
Kiosk, Bar, Cafe	One 208/120V, 3-Phase, 4-wire and one 480/277V, 3 Phase, 4 wire feeders, terminated in a 100 amps and a 60 amps fused disconnect switches, respectively.

10.3.10 Lightning Protection System

A grid of air terminals will be placed on the roof of the building as per NFPA 780 requirements. Down conductors and ground will be placed at approximately every 80 feet around the perimeter of the building. Building steel columns will be used instead of down conductors where possible.

10.3.11 Fire Alarm System

The fire alarm system will operate using an analogue and addressable type system. Fire alarm transponders will be strategically placed on each level to monitor multi zones of fire alarm devices. The main fire alarm control panels will be linked to the transponders with style7 class A wiring. The system will interface and be compatible with the Port Authority Central fire alarm system.

A remote Annunciation Fire Alarm panels will be located at the main fireman entrance on the first level. The Main Fire Alarm panel located at the Fire Command Station at the terminal engineer's office will be used to communicate the presence of an alarm condition in either public or non-public areas.

10.3.12 Manual Operation

An addressable manual pull station will be mounted at each exit stair and at every 200 feet along the path of egress to raise an alarm condition. Additional manual pull stations will be considered at other strategic positions.

10.3.13 Automatic Operation

Automatic detection will generally consist of point type addressable smoke or heat detection devices.

Smoke detection devices will be located in the areas as follows:

- Electrical sub-stations
- Electrical closets
- Communication rooms
- Elevator machine rooms
- Mechanical ventilation systems exceeding 2000 cfm
- Mechanical plant rooms.
- Elevator lobbies and shafts
- Both sides of fire doors/shutters
- Automatic door hold open devices

(Note : as the stairs are not pressurized during a fire, smoke detectors are not provided at the top of stairways)

Heat detection devices will be located in the areas as follows:

- Elevator machine rooms
- Elevator pits
- Both sides of fire doors/shutters

10.3.14 Audible and Visual Alarm

Annunciator of alarm will be communicated by horns throughout the terminal building to provide an audibility level of 20db above ambient noise level.

The visual indication will consist of flashing strobe lights located in general public areas, egress corridors, elevator lobbies and public toilet areas. The strobe light will have a minimum of 75 candela light output.

10.3.15 Mechanical Systems

An elevator recall system will be provided to recall elevators to the ground or alternate floor levels in the event of a Fire Alarm condition being raised.

Interface with baggage handling and mechanical ventilation systems will be provided to shut down as necessary.

10.3.16 Grounding System

Electrical grounding system will be provided with main copper bus grounded to main cold water pipe, building steel columns, ground ring and grounding rods. Steel columns will be grounded via grounding rods around the perimeter of the building. All the ground rods will be bonded to the grounding system. Wall mounted copper bus will be provided in each substation and communications closet.

10.3.17 Lighting in utility Areas:

The lighting in utility areas will be predominately high efficiency fluorescent fixtures with local switches.

The following table shows general ranges for lighting levels in non-public areas.

Lighting Levels	Foot candles
Baggage Handling	20-50
Stairways	10-20
Utility Rooms	20-30
Apron	1-5

Lamps will be rapid start T-8 fluorescent with electronic ballasts and compact fluorescent with high power factor ballasts. All lamps will have a color temperature of 3500k.

Pendant mounted Industrial type four-foot length fixtures will be used for electrical, mechanical, communication and utility closets.

Eight-inch exit lights will be used in office spaces and open areas. Standard edge lit red LED type exit lights will be used.

10.4 Plumbing

10.4.1 Codes and Standards

1. Building Code of the City of New York and associated reference standards
2. New York State Energy Conservation and Construction Code
3. Americans with Disabilities Act
4. PANYNJ Tenant Construction Review Manual
5. NFPA 415 - Construction and Protection of Airport Terminal Buildings

6. Brooklyn Union Gas Co. Construction Standards and Specifications
7. NFPA – National Fire Protection Association
8. New York State Department of Health Cross-Connection Control, Public Water Supply Guide

10.4.2 Domestic Water Systems

10.4.2.1 Cold Water Supply and Distribution System:

The source of the domestic water supply is a combined fire protection/domestic low pressure water main. For design purposes the summer water pressure will be used, 55 psi static and 50 psi residual at 2,000 gpm flowing.

The domestic water supply will consist of two independent domestic water services interconnected. In case of failure of one of the services the second service will provide the water supply for the entire terminal.

Each system will be provided with a curb valve, water meter assembly, backflow preventer, constant pressure type triplex pump system, hydromatic tank, distribution piping to plumbing fixtures and equipment. The piping system will be sized based on the maximum velocity of 8 fps in the water mains and approximately 4 fps for pipe branches to the fixtures and equipment.

Flush valves will be provided for water closets and urinals. In all public toilets hand sink faucets will also be automatic. Automatic valve actuators will be provided with back-up battery to assure continuous service in case of loss of power.

Ground type hydrants will be provided 300 feet apart around the terminal. Hose bibs will be required in all mechanical rooms, public toilets and food preparation areas where floor drains will be provided.

Backflow prevention devices will be provided on all water connection to fixtures and equipment as required by the New York City Building Code.

Where required, make up water will be provided to HVAC equipment.

All building water supply systems will be provided with shock absorbers installed at the end of long pipe runs, near batteries of fixtures and at quick closing valves.

Control valves will be provided at the base of each riser, on branches to each fixture or group of fixtures, on supply to equipment and on the mains. Metal tags will be provided to identify each valve.

For flexibility 1-1/2" cold water valved outlet will be provided for concession area basis per the Drawings.

Apron emergency shower stations and potable water cabinets will be fed from the domestic water system.

10.4.2.2 Hot Water Supply and Distribution Systems

A hot water distribution system will consist of gas fired storage type hot water heaters and distribution piping.

Hot water piping will be protected against freezing, water hammer affect, structural movement and contamination.

Electric water heaters will be provided near points of use for each remote toilet. For concessions' water usage a gas fired storage type water heater will be installed with hot water circulating system.

The 120°F degrees temperature will be maintained in hot water distribution system for a general use. The water for kitchens will be heated locally to 140°.

Hot water distribution system will be sized to a maximum velocity of 8fps in the mains and 4fp for pipe braches.

Automatic air-relief valves will be installed at all high points in the circulated hot water system.

10.4.2.3 Sanitary Sewage System

The sanitary system will convey waste by gravity from toilet room fixtures, floor drains and sinks, kitchen fixtures and equipment will drain through grease traps into the sanitary drainage system.

Sewer ejector duplex pump system will be provided in depressed floor areas. Sump pumps will be provided to drain the elevator pits.

Every sanitary drain will be equipped with a building house trap. A fresh air inlet will be provided on the system side of the house trap. For future Retail concessions 4" sanitary plugged outlet and 3" vent capped outlet will be provided per the Drawings.

10.4.3 Storm Water Drainage System

The storm water drainage system will convey roof water (via roof drains and leaders) under gravity to the site storm water system. Overflow provision will be provided. The storm water system carries storm water exclusively.

Storm system for connecting bridge will be provided by connecting roof drainage piping directly to the site storm drainage system.

Road bed drainage for the Departures Roadway will be integrated into the building storm water system. Departure level road rain water within the building envelope and departure level rain water collected outside of building envelope will be connected directly to the site storm drainage system.

10.4.4 Phased Construction/Future Expansion

The building will be constructed in one phase.

No allowance is being made in the design of the building systems for increases in area beyond the statements made in this report.

10.5 Fire Protection

10.5.1 Sprinkler System

The passenger terminal is classified as occupancy group F-3 according to the New York City Building Code. Reference Standard RS 17-2 classifies F3 occupancy as ordinary hazard.

Sprinkler and fire standpipe system shall be separate systems. Automatic sprinklers will be provided in all elevator machine rooms. Elevator shaft and pit sprinklers shall be installed in compliance with the applicable codes. Concealed conveyor spaces inaccessible to firefighting equipment will be provided with a sprinkler system. Spaces over all types of ceilings are considered inaccessible. Refer to Section 7.3 for interface of Baggage Handling System with fire protection system.

The passenger terminal building will be fully sprinklered and hydraulically calculated to meet the following criteria:

a. Sprinkler System Design Criteria:

1. Office Area	: Light Hazard
2. Public Area	: Ord. Hazard Group 1
3. Service Areas	: Ord. Hazard Group 1
4. Equipment Rooms	: Ord. Hazard Group 1
5. Storage Areas	: Ord. Hazard Group 2
6. Retail Areas	: Ord. Hazard Group 2
7. Baggage Handling Areas	: Ord. Hazard Group 2
8. Baggage Conveyors in Hung Clgs	: Ord. Hazard Group 2
9. Loading Dock Areas	: Ord. Hazard Group 1
10. Fixed Passenger Bridges *	: Ord. Hazard Group 2*

b. Minimum Water Density Requirements:

1. Light Hazard	: 0.10GPM/SQ. FT. X 1,500 SQ. FT.
2. Ord. Hazard Group 1	: 0.16GPM/SQ. FT. X 1,500 SQ. FT.
3. Ord. Hazard Group 2	: 0.18GPM/SQ. FT. X 2,500 SQ. FT.
4. Ord. Hazard Group 2*	: 0.20GPM/SQ. FT. X 1,500 SQ. FT.
5. Airside exterior wall glazing within 100' of aircraft (NFPA 416)	: Exterior glazing surface area : 0.25 GPM/SQ. FT.
6. Openings in interior fire rated walls	: Closely spaced (6'-0" O.C) Sprkl. 3.0 GPM/Lin.FT

7. Area of application for dry pipe sprinkler systems shall be increased by 30% without reducing the density per square foot.

c. Maximum Coverage per Sprinkler Head:

1. Light Hazard	: 225 Sq. Ft.
2. Ordinary Hazard Group 1	: 130 Sq. Ft.
3. Ordinary Hazard Group 2	: 110 Sq. Ft.

The source for the sprinkler system is the combined fire protection/domestic low pressure water main. The summer water flow test will be used for design purposes (55psi static, 50psi residual with 2000gpm flowing). The sprinkler system for the entire terminal will consist of two sprinkler services (one in the north end of the head house, the other in the south end of the head house). The wet sprinkler system will be looped within the entire terminal building. A double detector check valve assembly and automatic sprinkler pressure booster pump will be provided for each sprinkler service. In case of failure of one of the sprinkler services, the second service will satisfy the entire terminal sprinkler requirements.

Each automatic sprinkler pump will be sized to deliver a calculated sprinkler water demand to the most hydraulically remote area of the new terminal (including airside exterior glazing within 100ft. of aircraft).

Sprinkler siamese connections will be spaced at 300 feet (maximum) intervals around the terminal building. Sprinkler floor control assemblies will be controlling each sprinkler zone. Each zone will be no greater that 52,000 sq. ft.

Dry pipe sprinkler system will be provided for the loading dock, baggage stripping areas and exterior glass protection (where required by NYC Building Code) in the connection bridges.

Windows facing the ramp and if the potential fuel spill points are within 100ft of the glass will be protected by automatically operated deluge sprinkler system as required by NFPA 13, NFPA 415 and Port Authority requirements.

10.5.2 Fire Standpipe System

The source of the fire standpipe system will be low pressure water main. There will be three fire standpipe (FSP) services (two for the head house and one for the concourse) for the entire terminal building.

Each FSP service entering the building will be provided with a double check valve detector assembly.

A 6" fire standpipe cross connection will be provided and 4" FSP risers will supply hose stations on every floor of the terminal.

Fire standpipe siamese connections spaced not more than 300ft apart will be provided around the terminal building.

10.6 Natural Gas Piping System

Natural gas service will be provided by the local utility company (KEYSPAN) at a pressure not to exceed 15 psi and a minimum pressure of 5 psi to the gas meter room where it will be reduced not to exceed 1-1/2 psi. The encasing service pipe and the gas pressure regulator will be vented separately through the roof. The gas service will provided with a single meter as per the utility company requirements. The gas meter room is accessible from outside the building, is ventilated and of 2 hr. rated construction.

Gas piping within the building will be sized for a pressure drop of 1 (one) psi to provide a minimum of 8" wc at the most remote gas fired unit. Gas pressure regulators will be provided at each gas fired unit.The piping system will supply gas to Domestic water heaters, to Concession areas for cooking and domestic water heating and to Inbound baggage and outbound bag stripping area, low intensity radiant heaters.

Gas piping within the building operating at a pressure of over 1/2 psig to 3 psig and of a size 4" or larger shall be welded. Gas piping of a size smaller than 4" shall have threaded fittings. (NY City Building Code, P115.7 and P115.8). All piping shall be black steel, standard schedule 40, ASTM A53 .

10.7 Acoustics

10.7.1 Recommended Acoustics Design Targets

10.7.1.1 External Noise Intrusion Criteria

The design of the building envelope will determine the level of exterior noise that penetrates into the interior of the terminal.

Different noise criteria are therefore required for passengers and for staff. Tables A1 and A2 give the recommended maximum continuous and intermittent noise levels.

Table A1 presents design targets which apply to the noise from events with a duration typically less than 30 seconds, primarily aircraft take-offs and gate arrivals.

Space	Maximum Level, dB(A)
Landside Check-in	70
Hold Rooms	70
Circulation	70
Concessions/Marketplace	70
Baggage Claim	70
Security	70
Offices	60
Conference/Training Rooms	60

Table A1 – Maximum Allowable Noise Levels from Events of Short Duration

Space	Continuous Level, dB(A)
Landside Check-in	55
Hold Rooms	50
Circulation	50
Concessions/Marketplace	50
Baggage Claim	55
Security	50
Offices	45
Conference/Training Rooms	45

Table A2 – Maximum Allowable Continuous Noise Levels from External Events

10.7.1.2 Sound Separation Criteria

The sound reduction performance of conventional walls, doors, and floor / ceiling assemblies is described in terms of a criterion commonly referred to as Sound Transmission Class (STC). Proposed STC ratings for critical walls are proposed in Table A3 below:

Partition Wall Separating	STC Ratings
Mechanical Room Office and Locker Room	55
Mechanical Room and Corridor	50
Mechanical Room and Terminal and Concourse	50
Baggage Handling and Office	60
Baggage Handling and Corridor	50
Between General Offices	40
Conference / Training Rooms and Offices	45

Table A3 – Internal Sound Isolation Targets

10.7.1.3 Room Acoustic Criteria

The room acoustic conditions are determined by room geometry and room finishes. The room acoustic conditions are important, particularly in airport terminals as they have a major impact on the following:

- Occupational noise build up
- Speech intelligibility of the public address system
- Passenger and staff comfort and communication ability

The parameter most commonly used to describe the room acoustics of a space is reverberation time (RT) which is defined as the time taken for a given noise or sound source signal to decay by 60 dB. (i.e. a shorter reverberation time indicates that a room will be quieter). The area of sound absorbing treatments within a space along with the volume/height of the space, determine the reverberation time.

People Noise

To ensure that speech is clearly audible at normal conversational levels, the ambient noise level should not exceed 65 dB(A) at the communication point.

As a general guideline, the ambient noise generated by people throughout the terminal should not exceed 65 dB(A). The quantity of sound-absorbing material used to achieve this will be dependent on the population densities in each area, and typical number of people talking simultaneously. (Typically 20-25% of the total population).

Public Address System

In order to achieve appropriate speech intelligibility from the public address system, the quantity of sound absorbing material required will be dependent on ceiling height, and the type of loudspeakers being used in each space.

Sound Absorbing Finishes

Generally, a minimum of 50% sound absorbing material will be required on all ceilings, regardless of their height, to ensure the acoustic environment is controlled.

It is anticipated that in areas where the ceiling height is low (between 10 and 15 feet), such as holding rooms, or high (30 feet or more), such as Land Side Check-in, 100% of the ceiling will need to be covered in sound absorbing material. In the Marketplace or Concourse circulation, between 50 and 75% of the ceiling will need to be covered in sound absorbing material.

Reverberation Time Targets

The proposed reverberation time limits are presented in Table 4. The limits assume that a minimum STI value of 0.45 is achieved with appropriate loudspeakers. Table 4 also provides a rough estimate of the percent coverage of the ceiling with sound absorbing material assuming an absorption coefficient of 0.75 at 500 Hz – 2000 Hz.

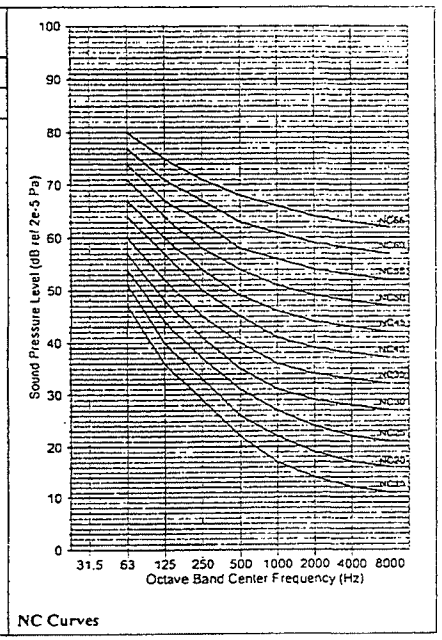
Interior Space	Ceiling Height	Mid Frequency Reverberation Time (Average of 500, 1000, 2000 Hz Octave Bands)	Minimum Percentage of Ceiling Sound Absorbing (Initial Estimate)
Land Side Check-in	25-35 ft	1.5-2.0 seconds	100%
Hold Rooms	10-12 ft	0.8-1.0 second	100%
Concourse Circulation	15-20 ft	1.2-1.5 seconds	50-75%
Concessions / Marketplace	25-35 ft	1.5-2.0 seconds	75-100%
Baggage Claim	10-15 ft	0.8-1.0 second	100%
Air Train Connector	15-20 ft	1.2-1.5 seconds	50-75%
New Flight Wing	8-12 ft	1.0-1.2 seconds	50-75%
Passenger Screening	25-30 ft	1.2-1.5 seconds	100%
Offices	8-10 ft	0.4-0.6 seconds	100%
Conference / Training Rooms	8-10 ft	0.4-0.6 seconds	75% *25% sound absorption on two walls, 25% on the ceiling
Break Rooms / Locker Rooms	8-12 ft	0.6-0.8 second	100%
Main Comms Room	8-12 ft	0.4-0.6 seconds	100%
Workshops	15-20 ft	1.2-1.5 seconds	50-75%

Table 4 – Mid Frequency Reverberation Time Criteria

10.7.1.4 Mechanical Design Criteria

The design targets for background noise from building services are presented in Table A5.

Occupied Space	Design Noise Criteria
Landside Check-in	NC 45-50
Hold Rooms	NC 40-45
Concourse Circulation	NC 40-45
Concessions / Marketplace	NC 40-45
Baggage Claim	NC 45-50
Air Train Connector	NC 40-45
New Flight Wing	NC 40-45
Restrooms	NC 40-45
Passenger Screening	NC 40-45
Security	NC 35-40
Offices	NC 35-40
Conference Room	NC 35
Training Room	NC 35

Break Rooms/Locker Rooms	NC 35-40	
Workshops	NC 40-45	
Main Comms Room	NC 35-40	
Mechanical Rooms	NC 65	

NC Curves

Table A5 – Mechanical Services Design Noise Criteria

During a fire emergency, when a smoke extract system is needed, the background noise target should not exceed NC 70

10.7.1.5 Equipment Noise Criteria

Baggage Handling System

In rooms where baggage handling systems are concealed from view (e.g. they are mounted in an enclosure above the ceiling or in a separate enclave) the noise from these systems

Table A6 presents the recommended noise criteria for machinery noise. These noise levels are to be measured at a distance of 3 feet from the noise producing components.

Equipment	Noise Criteria, dB(A)
Belts at Check In Counter	65
Baggage Reclaim Carousel	70
Belts in Ceiling Space Above Noise Sensitive Areas (Offices)	55
In Bag Room and Non-Occupied Areas	75

Table A6 – Criteria for Equipment Noise, Measured at 3 Feet

Moving Walkways and Escalators

Noise levels while traveling along the moving walkways or escalators at a height of 5 feet or within 3 feet of the sides and ends of the walkway/escalator should not exceed 65 dB(A).

Elevators

Noise levels within elevators at a height of 5 feet and at 3 feet from doors should not exceed 65 dB(A).

Vibration Levels

Vibration sources include mechanical systems, baggage systems, moving walkways, escalators and elevators. Recommended targets are based on the international standard ISO 2631 that limits annoyance due to feelable vibration as follows:

- No occupied public area should be subjected to one third octave band vibration levels (1Hz to 100Hz) in excess of 0.032 in/sec rms. In staff areas the level should not exceed 0.016 in/sec rms.
- Vibration levels measured at a distance of 3'-0" from any contact point of the airport machinery or building services systems whilst under normal operating loads and conditions should not exceed 0.032 inch/sec rms.

10.8 Public Address System Criteria

10.8.1 Emergency Usage of the Public Address System

The public address system will be used for public address announcements, but may also be used for emergency messaging. NFPA 72-1999 and the international standard for emergency public address systems, IEC 60849 both now require that the system provide a minimum specified level of speech intelligibility. Although there is no code obligation to meet these standards on this project, the public address system will meet a minimum target standard to ensure that speech messages, whether for general paging or emergency use, are clearly understood within the terminal.

10.8.2 Public Address System Audibility Design Targets

The intelligibility of the public address system is highly dependent on a controlled level of background noise and on the room acoustic design. In order to achieve appropriate speech intelligibility, the following public address system design targets will be pursued:

Description	Design Targets
Short Sentence Intelligibility (ISO TR 3352)	> 95%
Speech Transmission Index (IEC 269 as measured using the RASTI method)	0.50 STI in all public areas, minimum on-site acceptance - no less than 0.45 at any location (with

	15dB S/N @ 2kHz)
Signal to Noise Ratio	+ 15 dB @ 2 kHz
Signal Level	> 65 dB(A) but < 85 dB(A)
System Frequency Response	100 Hz – 10 kHz, - 5 dB (for high quality public paging and background music production) 200 Hz – 6.3 kHz, - 5 dB (general public paging, speech only) 400 Hz – 4 kHz, - 5 dB (for noisy spaces and non-public areas, such as plant rooms and service corridors)

Table A7 – Public Address System Design Targets

In areas with ambient noise sensors the recommended undistorted maximum operating average speech sound level is not less than 85 dB(A) when reproducing typical speech broadcast and a minimum level of 65 dB(A). The recommended ambient noise settings should maintain a signal to noise ratio of 15 dB at 500 Hz, 1 kHz, and 2 kHz between the average speech level and the average ambient noise level.

In areas without ambient noise sensors it is recommended that the system should be set to the following speech sound levels:

- Offices 65 –70 dB(A)
- Toilets 65 –70 dB(A)
- Service Corridors 70 –75 dB(A)

10.9 Building Automation (BA) / Building Management System (BMS)

10.9.1 General

The BMS will be integrated with the other terminal system.

10.9.2 Controls Philosophy

The building automation will be via a building management system (BMS) providing the control and monitoring of building systems via Direct Digital Control (DDC).

The BMS for the entire terminal will be provided by one of a list of pre-approved vendors that will be developed.

10.9.3 System Architecture

The BMS system architecture will be as follows:

- Stand-alone intelligent DDC outstations connected via a proprietary bus/ring network (peer-to-peer) and network controllers.
- All outstations will be of modular design, allowing for future expansion of control and monitoring points.
- Outstations shall be located in the MERs and other equipment rooms.
- Two system supervisor multi-user, multi-tasking workstations connected to the outstation network shall act as a window to the system. The supervisor workstations will be located in the building managers/engineers rooms and will provide the capability of monitoring and controlling the systems, recording operations and receiving alarms, trend-logging and will be user configurable for data collection, manipulation and presentation.
- Capability of connecting more than two supervisors to the BMS as the need arises shall be included.
- Capability of performing all supervisor functions via a laptop connected to any outstation in the field shall be provided.
- Capacity of communication (read and write information) with remote locations via Internet and/or internal airline intranet using standard Web Browser technology supporting HTML and/or JavaScript.
- Wireless capabilities will include remote alarm and maintenance notification utilizing standard beepers, cell phones, Blackberry, etc. Additionally if desired system could be configured to allow operator workstations to communicate via wireless LAN.
- Control valves and dampers will generally have electric actuators, but the possibility will be examined for utilizing pneumatic actuators for large control valves and control dampers.
- Intelligent unitary DDC controllers (mainly for the control of the VAV boxes and FCUs) shall be distributed in the building and networked and connected via network controllers to the BMS-outstation networks (master/slave or peer to peer – bus/ring networks).
- New emerging technologies for an "Open System Architecture" will be investigated for possible implementation. Even if an Open System Architecture is not implemented at the Construction Documents stage, only systems will be considered that will allow a migration path in this direction (i.e. systems that will not be obsolete in the near future).
- BMS systems will not be Y3K compliant

10.9.4 Functions

The BMS will have the following functions:

- To control and monitor the mechanical systems in order to achieve the required environment within the building.
- To manage the building equipment efficiently and conserve energy usage.
- To optimize the operation of the equipment in order to achieve longer life-cycles and less required maintenance.
- To act as a central monitoring and alarming facility for MEP systems.
- To increase the productivity of the operating and maintenance personnel.
- To provide a tool for the quick and efficient change of the space setpoints and other parameters.
- To interface with any proposed Facility Management System (and within it the Planned Maintenance System) to provide an efficient management tool for the terminal.

10.9.5 Scope

The BMS will provide control and monitoring of the following building systems and functions:

- Building chilled water distribution system.
- Building hot water distribution system (medium temperature, low temperature glycol etc.)
- Air handling units
- VAV boxes and Fan Coil Units (FCUs)
- Heating and ventilating units
- Exhaust fans
- Aircraft loading walkway pressurization fans
- Motorized Blinds/Shading Devices, if any
- Smoke purge
- Programmed start-stop of systems

- Monitoring of space conditions
- Alarm annunciation
- Preventative maintenance alarms
- Metering of chilled water, hot water, domestic water
- Duty cycling
- Sequential start-up of plant following power loss
- Operating logs
- Trend logs and forecasting
- Instrument air system monitoring, if required
- Export of current database information of all plant and equipment to the Facilities Management System (FMS)
- Interfaces to the security and fire alarm systems, lighting system and airport information systems– if required

10.9.6 Typical Air Handling Unit Control and Monitoring

The following control and monitoring functions will be provided for air handling units as relevant:

- Remote start/stop
- Programmed start-stop based on time of day or area occupancy information from airport information systems
- Establishing warm-up, cool-down, and normal modes of operation depending on time and occupancy. Temperatures setpoint adjustment depending on the mode of operation.
- Temperature control: Modulation in sequence via a PI control loop of the heating coil control valve the outside air, mixing air and exhaust air dampers and the cooling coil control valve, to obtain the temperature setpoint of the supply/space or return air. Use of reset/cascade control where appropriate. On VAV-plant supply air temperature setpoint reset based on the VAV-controllers outputs.
- Variable volume control: supply fan speed control to maintain the static pressure setpoint. Fan tracking – exhaust fan speed control via air flow measurement.
- Minimum fresh air control of outside air, return air and spill air dampers. Outdoor air will be varied in response to measured CO_2 levels and based on occupancy.
- Economizer controls (enthalpy override) for free-cooling.
- Control of maximum relative humidity.
- Filter alarms.
- Set point adjustment.
- Smoke detection and smoke purge/clearance.
- Addressable VAV-boxes controls and addressable FCU controls.
- Freeze protection and alarm
- High/Low pressure alarm and control

10.9.7 Lighting Control

The BMS will also control motorized blinds, if used. Any interfaces with the lighting control system are yet to be determined.

10.9.8 *Smoke Purge*

A smoke purge panel shall be installed at a location approved by the Fire Marshall. The panel shall be visually similar and compatible with the Fire Alarm Annunciator Panel specified under the Electrical Section.

The smoke purge panel shall have running lights to monitor the status of each fan and control switches permitting manual override of the fan controls (start/stop as necessary on full speed – to this respect VFD bypass contactors will be provided for all VAV fans used for smoke management). The panel shall have a door provided with keylock flush handle and plexiglass window, permitting the lights and switches to be seen but not tampered with.

A graphic of the building showing fan and area serviced by each fan is to be provided at the top portion of the "smoke purge panel".

Smoke purge will be carried out via the BMS which will be approved for use in this capacity in New York City.

10.9.9 Calpine System Monitoring and Control

All field instrumentation required to control and monitor the supply of MTHW and CHW to the building shall be industrial grade (Rosemount, Gould, Moore Products, Foxboro, etc.).

10.9.10 Electrical Supply for BMS

Electrical installation shall be in accordance with the applicable requirements of the Electrical Sections of this specification. All controls system power shall be drawn from a standby panel.

10.10 Conveying Systems

10.10.1 Elevators

Complete elevator systems complying with the applicable local codes and including the following:

a. **Terminal Building:**

1) **Air Train Connector Elevators:** One four stop and one three stop gearless traction or roped hydraulic types; selective-collective operation. Hoistway entrances to be satin finished stainless steel. Cabs may have textured stainless steel wall panels, diamond plate stainless steel floors, and satin finished stainless steel ceilings with recessed lighting.

2) **Public Elevators:** The public elevators connect the Food Court Market Plaza on the Departure/Concourse level with the Baggage Claim area on the Arrivals level are located between the public staircases. Two, two stop, gearless traction or roped hydraulic types; selective-collective operation. Hoistway entrances may be satin finished stainless steel. Cabs to have textured stainless steel (Rigitex) wall panels, diamond plate stainless steel floors, and satin finished stainless steel ceilings with recessed lighting.

3) **Service Elevators:** Two, two stop and one, three stop gearless traction or roped hydraulic passenger/service types; up collective operation. Hoistway entrances to be satin finished stainless steel. Cabs may have textured stainless steel (Rigitex) wall panels, diamond plate stainless steel floors, and plastic laminate ceilings with recessed lighting.

10.10.2 Escalators:

a. **General:** Complete 'heavy duty' escalator systems complying with the applicable codes. Heavy duty escalators shall be understood to mean escalators that are designed specifically for use where high-traffic volumes, such as will be expected in an airport facility or metropolitan transit system, will produce dense occupancy and structural, machinery, and brake loads that are much higher than normal for a commercial office building or suburban shopping mall.

b. **Escalator Systems:**

1) Two, parallel adjacent, nominal 40" wide steps and approximately 48" between balustrades, with glass balustrades and brushed stainless steel fascias connecting the Food Court Market Plaza on the Departure/Concourse level with the Baggage Claim area on the Arrivals level.

2) Two, parallel adjacent, nominal 40" wide steps and approximately 48" between balustrades, with glass balustrades and brushed stainless steel fascias connecting the AirTrain Connector Level to the Departure/Concourse level.

10.10.3 Moving Walks

Complete moving walk systems complying with the applicable codes.

b. **Air Train Connector**: Sets of parallel, nominal 40" wide tread-way pallets, with glass balustrades and stainless steel skirt guards. Single speed type, arranged to operate at minimum 100 fpm. The moving walkways will be equipped with a SCADA connection back to a PANYNJ head end system.

10.10.4 Passenger Loading Bridges

The passenger boarding bridges shall directly interface with the new building façade at the departure/concourse level. Primary features as follows:

a. **Panel Controls:** A control panel shall be located in the head of the apron drive type bridges that allows a single operator to control the bridge functions while maintaining a clear view of the apron. Variable speed controls, full sensors, and a telescoping head will permit the operator to precisely and safely position the bridge during docking without damaging the aircraft or the bridge during operation. An auto leveling unit will also be specified that will ensure the bridge remains properly aligned with the aircraft.

b. **Additional Features**: Additional features to be specified for each apron drive bridge will include:

1. A service door and stair near the head of the bridge.
2. Hinged transition ramps to accommodate the differences in elevation where telescoping tunnel sections overlap.
3. Weatherproof canopy that conforms to narrow and large diameter aircraft.
4. All power/controls for the bridge, a 400Hz power source, potable water with heat trace components and preconditioned air unit inside of the bridge.
5. Interior Finishes:
   a) Floors: Non-ribbed, patterned, rubber flooring shall be applied to the bridge subflooring from the aircraft end of the bridge to the terminal side of the service door.
   b) Walls: The tunnel wall treatment shall consist of floor to ceiling high pressure laminated veneered fire retardant treated particleboard panels. Wall finish treatments in the pivoting sections (rotunda and cab support) shall be galvanized steel slats.
   c) Ceilings: The ceilings shall be finished with plank type metal panels, which are individually removable.

Appendix A

Planning Day Schedule

jetBlue AIRWAYS

JFK International Airport Terminal 5 Redevelopment

Basis of Design Appendix A: Planning Day Schedule

ARUP
Design Manager

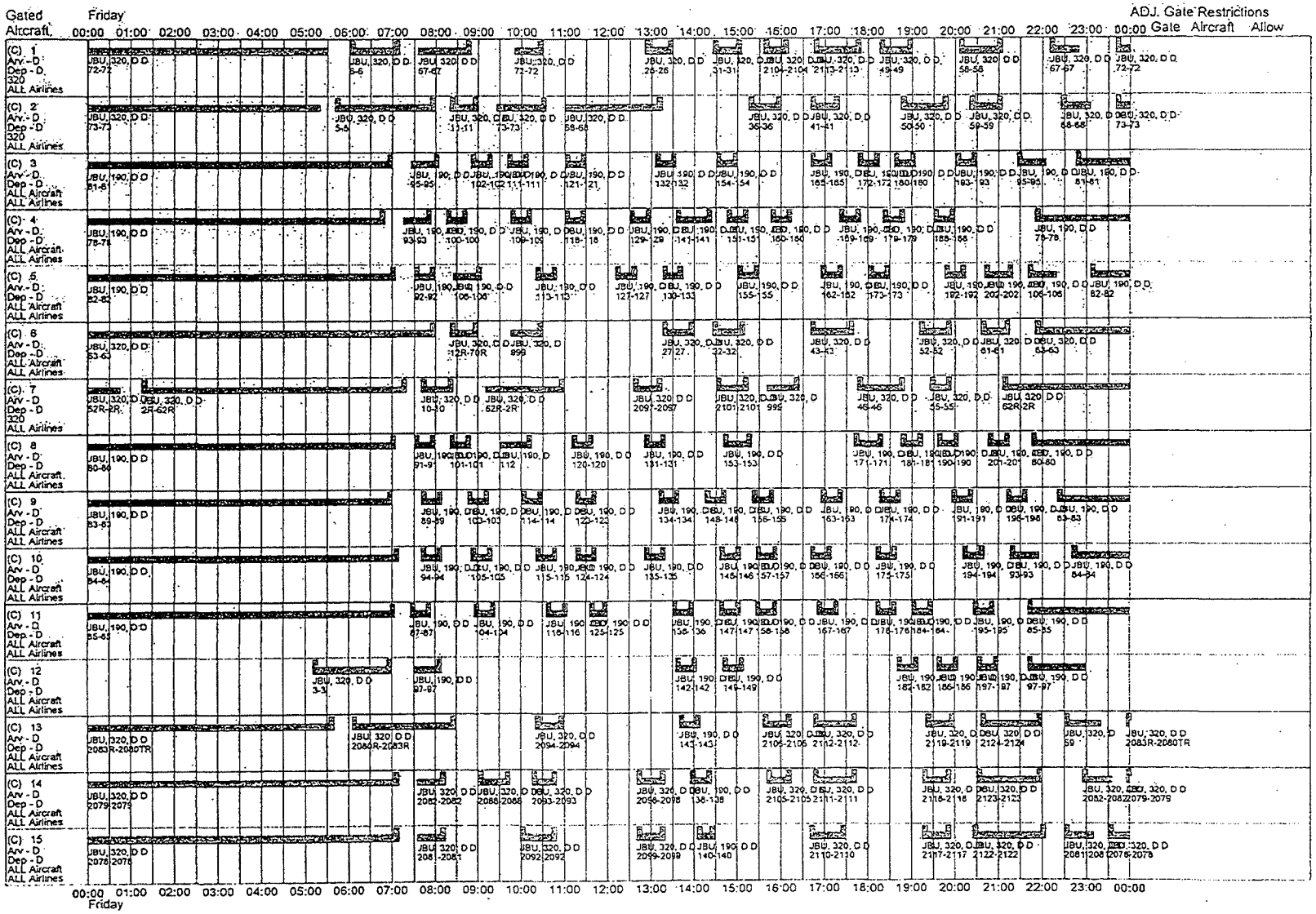
Gensler
Architect

DMJM HARRIS
Airside/Landside Engineer

ArupNapa

jetBlue JFK 26 Gate T5 Schedule

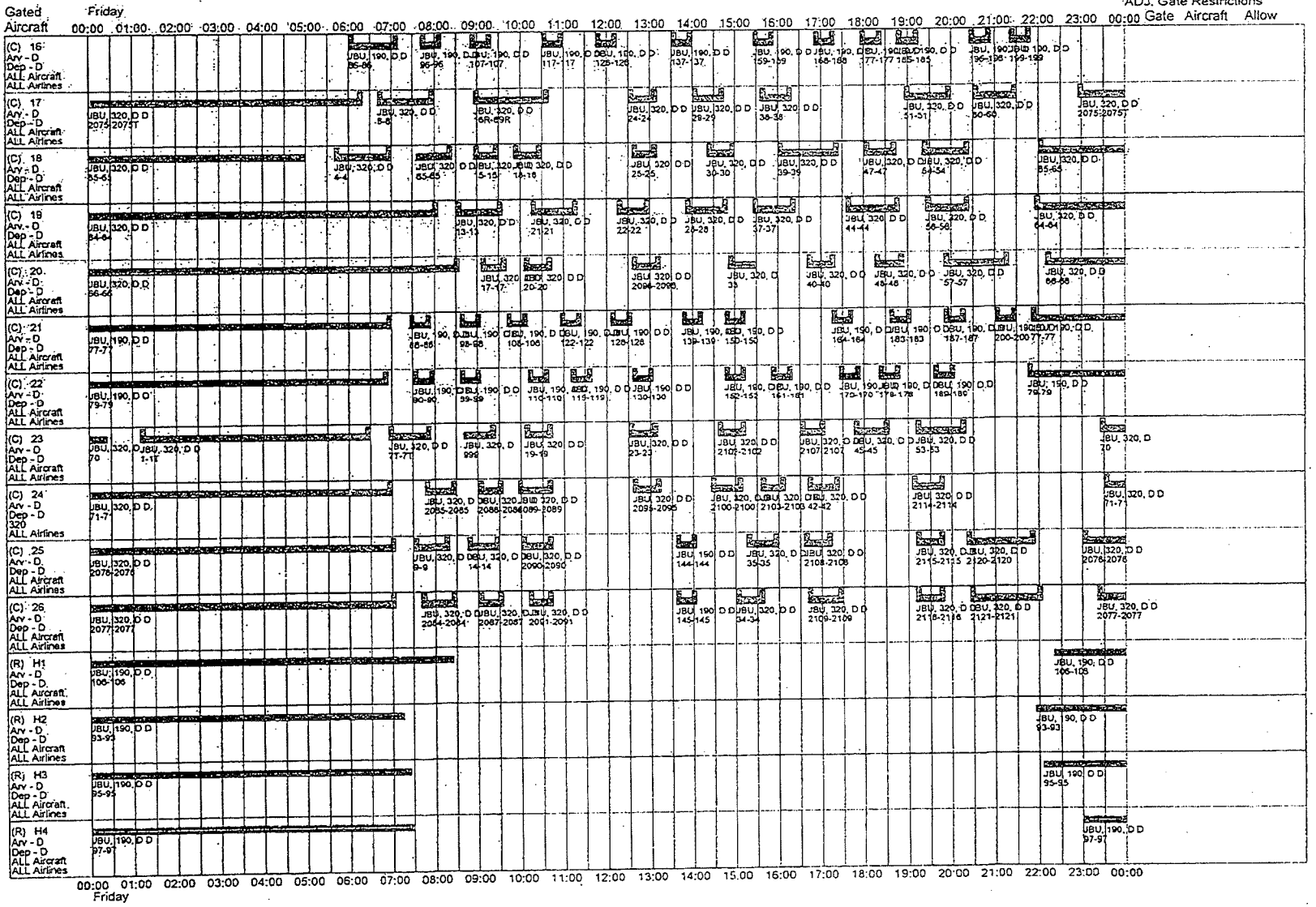
Friday 12/20/2002 - Friday 12/20/2002



ArupNapa

jetBlue JFK 26 Gate T5 Schedule

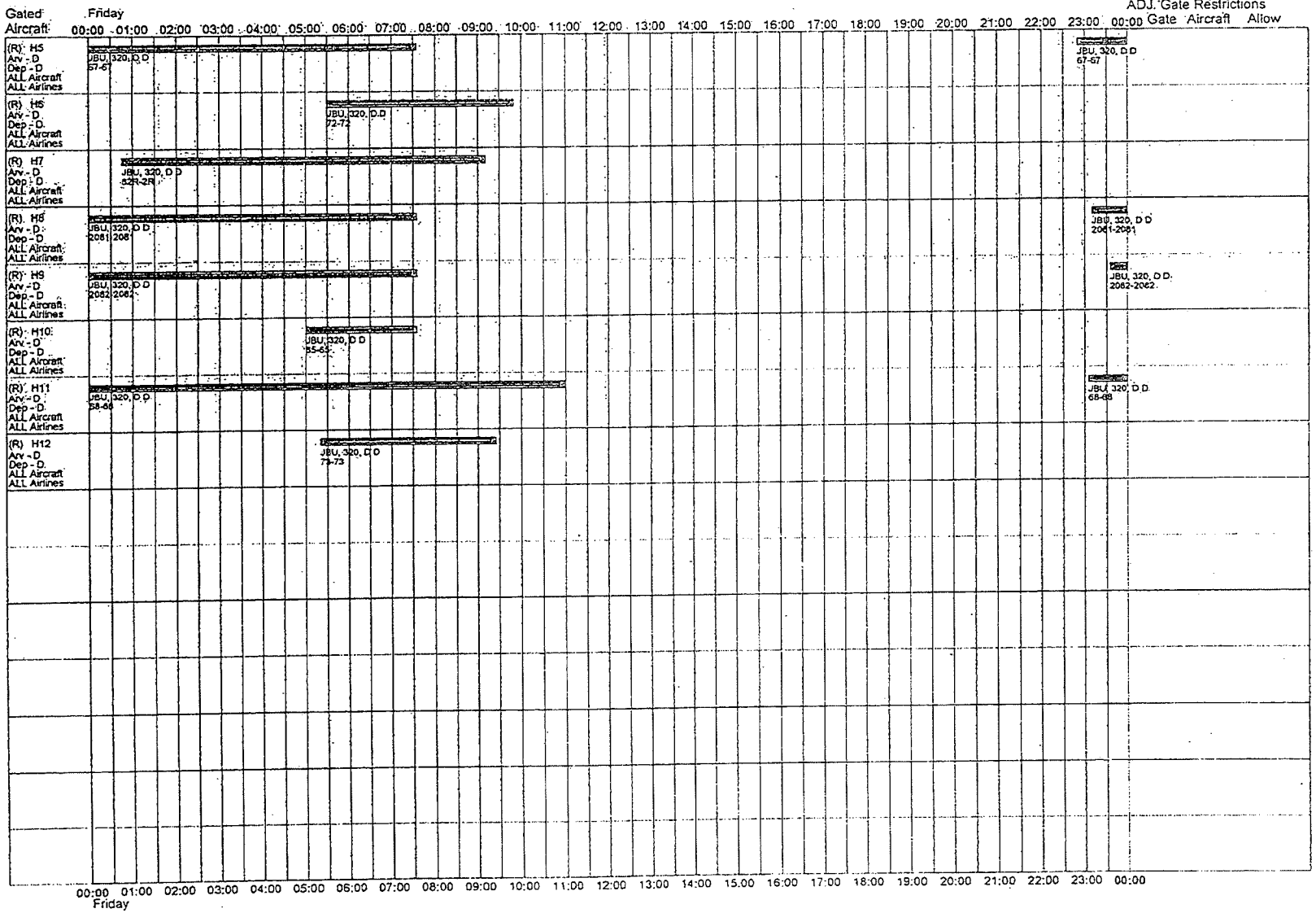
Friday 12/20/2002 - Friday 12/20/2002



ArupNapa

jetBlue JFK 26 Gate T5 Schedule

Friday 12/20/2002 - Friday 12/20/2002



Appendix B

Landside Demand and Traffic Analysis

jetBlue
AIRWAYS

JFK International Airport Terminal 5 Redevelopment

Basis of Design Appendix B: Landside Demand and Traffic Analysis

ARUP
Design Manager

Gensler
Architect

DMJM HARRIS
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1. INTRODUCTION

1.1 Issues addressed in this report

This report addresses the following landside planning issues:

- Demand
- Planning parameters
- Curb frontage analysis
- Parking analysis
- Operations of intersections 51 and 42

1.2 Landside constraints on terminal growth

Regardless of landside improvements at Terminal 5, three locations on the existing landside at Terminal 6 will constrain the sector's ability to sustain traffic growth. These are shown in Figure 1 below. Section 7 of this report discusses how the expected traffic generated by Terminal 5 will impact traffic operations at these locations. JetBlue will not undertake any modifications to the roadways or intersections that result in a revised Level of Service less than C.

1.2.1 Intersection 51

Intersection 51 will serve all traffic exiting Terminals 5 and 6.

1.2.2 Intersection 42

Intersection 42 will serve traffic approaching Terminal 6, traffic exiting the Saarinen building frontage, and traffic exiting both arrivals and departures frontages at Terminal 5.

1.2.3 Sector exit roadway

This two-lane underpass carries all Terminal 5 and 6 exit traffic under the Terminal 7 approach roadway.

EXEMPTION (4) – DRAWINGS OF NON-PUBLIC AREAS

2. DEMAND

The planning day schedule (see BoD Appendix A) is for 248 flights in each direction. This schedule consists of A320 and EMB190 flight movements. While the planning schedule has remained constant throughout the planning process, minor changes in aircraft seat capacity have made reference to load factor obsolete. The following table contains the enplaning/deplaning and originating/terminating customer loads used in the planning schedule. Note that the transfer percentage, and therefore the originating/ terminating volumes, varies by time of day.

Planning Day Schedule Customer Volumes					
Aircraft	Enplaning & Deplaning	Originating & Terminating			
	All Day	Early AM*	AM/PM	Late PM	Latest PM
A320	146	131	117	131	146
EMB190	80	72	64	72	80

Early AM is departures before 9:05 and arrivals before 8:25
AM/PM is departures 9:06-21:29 and arrivals 8:26-20:25
Late PM is departures after 21:30 and arrivals 20:26-22:30
Latest PM is arrivals after 22:30

Table 1: Planning Day Schedule Customer Volumes

Specific traffic parameters associated with the planning day schedule include:

- Daily Arrivals: 23,240 customers on 248 flights
- Daily Departures: 23,240 customers on 248 flights
- Peak Hour Arrivals (Terminating): 1,970 customers on 20 flights (18:30-19:30)
- Peak Hour Departures (Originating): 2,625 customers on 25 flights (07:45-08:45)
- Additional average 20% transfer customers (varies by time of day)
- Additional 20% wellwishers & greeters

The preceding peak hour volumes are based on flight arrival and departure times. The following are the peak hour volumes of originating/terminating customers entering and exiting the terminal:

- Peak Hour Terminating Customers Exiting Terminal: 2,081 (18:50-19:50)
- Peak Hour Originating Customers Entering Terminal: 2,279 (6:45-7:45)

The distribution of terminating customers exiting the terminal after arriving on a flight is determined by the interaction of a number of factors including: walking speed, checked baggage characteristics and baggage system performance. As such, this is an output rather than an input to the simulation model as described in Appendix C.

The following distribution (shown in both tabular and graphic form) was used to generate the volume of customers entering the terminal.

Originating Customer Arrival at Terminal	
Time prior to scheduled flight departure (minutes)	**Percentage of originating customers entering the terminal**
150-120	2
120-100	5
100-80	12
80-60	22
60-40	38
40-20	21
20-0	0
Total	**100%**

Table 2: Originating Customer Arrival at Terminal

The road system is based on the composite peak hour (entering/exiting) which is slightly off-set from the arrivals peak and has the following characteristics:

- Total Customers: 3,624 (18:45-19:45)
- Terminating Customers in Composite Peak Hour: 2,020
- Originating Customers in Composite Peak Hour: 1,604

3. PLANNING PARAMETERS

This section summarizes the planning parameters used to estimate landside demand in terms of vehicle traffic on the terminal curbside, parking area, and roadways. These planning parameters are based on field surveys of JetBlue customers at Terminal 6, conducted in April and May, 2003. The method for the data collection was customer intercept surveys conducted by JetBlue crewmembers. Only customers were surveyed. No survey of employees was undertaken. These parameters differ from the Port Authority's standard Central Terminal Area (CTA) planning parameters. Each subsection below highlights the differences between the CTA parameters and the JetBlue observed parameters.

The parameters discussed in this section impact on program requirements as follows:

- The mode split, vehicle occupancy, curb dwell time, and proportion to curb parameters are used to estimate **curbside frontage** requirements.
- The mode split, vehicle occupancy, parking duration, and proportion to parking parameters are used to estimate **parking space** requirements.

- The mode split, vehicle occupancy parameters are used to estimate **vehicle traffic** on roadways.

3.1 Mode split

Mode split refers to the proportion of customers using each mode of transportation to the airport landside. The JetBlue parameters are based on Spring 2003 intercept surveys in which customers were asked how they traveled to the airport. The sample size for these parameters was 865 customers[1].

Mode	JetBlue mode split		CTA mode split	
	Arrivals	*Departures*	*Arrivals*	*Departures*
Private autos	46%	30%	37%	37%
Taxis	10%	14%	18%	18%
For hire vehicles	12%	16%	14%	14%
Shuttles/limos	6%	19%	16%	16%
AirTrain	26%	21%	15%	15%

Table 3. Customer mode split parameters

The JetBlue parameters show more customers (21% of departures and 26% of arrivals) using the AirTrain that the PA parameters (15% in each direction). The JetBlue parameters were calculated by summing up public transit bus customers and customers using modes existing in 2003 that were scheduled to be replaced by the AirTrain. These replaced modes include:

- PA bus to the subway
- Long-term parking bus
- Rental car shuttle buses

Importantly, the JetBlue parameters are strictly empirical. No assumptions about induced mode shift due to AirTrain (customers taking the AirTrain instead of driving to the curb, for instance) have been made.

3.2 Vehicle occupancy

Vehicle occupancy refers to the mean number of customers entering and exiting vehicles on the curb frontage. The JetBlue parameters are based on Spring 2003 intercept surveys in

[1] The parameters are the upper bound of a 95% confidence interval around the mean found through the sampling process. This means that the probability that the actual parameters are no higher than the parameters adopted is 95%.

which customers were asked how many other customers traveled with them to the airport. The sample size for these parameters was 865 customers[2].

Mode	JetBlue customers per vehicle		CTA customers per vehicle	
	Arrivals	*Departures*	*Arrivals*	*Departures*
Private autos	1.9	1.2	1.5	1.5
Taxis	1.7	1.4	1.5	1.5
For hire vehicles	2.0	1.5	1.2	1.2
Shuttles/limos	1.6	4.3	10.0	4.5
AirTrain	N/A			

Table 4. Vehicle occupancy parameters

Unlike the CTA parameter, the JetBlue observed auto occupancy varies between departures (1.2) and arrivals (1.9). However, this is internally consistent with, and on the same order of magnitude as, the variation between observed dwell time for departures (1.3) and arrivals (1.8), meaning that the population of private auto drivers differs in the arriving and departing direction.

3.3 Dwell time

3.3.1 Curb dwell time

Curb dwell time refers to the amount of time a vehicle stands on the curb frontage to wait for, load, and unload customers. The JetBlue parameters are based on Spring 2003 passive observation of the Terminal 6 frontage. The sample size for these parameters was 334 vehicles[3].

Mode	JetBlue Dwell time in minutes		CTA Dwell time in minutes	
	Arrivals	*Departures*	*Arrivals*	*Departures*
Private autos	1.8	1.3	3.3	3.3
Taxis	1.6	0.9	1.4	1.4
For hire vehicles	3.0	1.9	2.9	2.9
Shuttles/limos	2.0	2.2	1.8	1.8
AirTrain	N/A			

Table 5. Curb dwell time parameters

[2] See note 1.
[3] See note 1.

Based on empirical surveys conducted at Terminal 6, JetBlue dwell times differ significantly from the Port Authority's CTA parameters. From these data, we concluded that the JetBlue customers using Terminal 6 dwell for significantly shorter than customers at other JFK terminals. There are at least two reasons for this:

- JetBlue departures vehicle occupancies are lower than the JFK-wide average, meaning fewer customers and pieces of luggage are unloaded from each vehicle. Typically, dwell time and vehicle occupancy are positively correlated.
- In 2003, JetBlue carried only domestic traffic, meaning they carried less luggage and were more familiar with the JFK Central Terminal Area. Domestic traffic also correlates with lower vehicle occupancy.

3.3.2 Parking duration

Parking duration refers to the amount of time vehicles spend in the paid parking lot. The JetBlue parameters are based on Spring 2003 customer intercept surveys. The sample size for these parameters was 865 customers[4].

Mode	JetBlue Parking duration in minutes	
	Arrivals	*Departures*
Private autos and For-hire vehicles	110	110

Table 6. Parking duration parameters – hourly parking

3.4 Proportions using curbs, parking, or both

The following table shows the proportion of private auto customers who were assumed to use the parking area, including those who use both curb and parking. In this case, the parking area refers to the paid parking lots in the Terminal 5/6 sector. Customers who drive to the airport and park in Long-Term Parking lots are assigned to the AirTrain mode, since these customers use the AirTrain to reach the terminal.

The proportion using parking, as described in the following table, is the customer mode split, not the vehicle mode split. In the subsequent modeling, customers were first assigned to the private vehicle mode, and then the subset of customers using parking was converted to vehicle using the median parking vehicle occupancy of 1.22 customers per vehicle. This parameter and the proportions using parking, are based on Spring 2003 customer intercept surveys, in which customers who traveled to/from airport in private autos and for-hire vehicles (arrivals only) were asked whether they used the parking lot. Total sample size for this analysis was 106 customers[5]. It should be noted that the data was collected from JetBlue customers. In the event that a customer was driven to the airport by a wellwisher who then parked, that customer would be counted as "curb and parking". The 1.22

[4] See note 1.
[5] See note 1.

customers per vehicle ratio refers only to the number of customers and does not include any wellwishers or greeters.

Customer sector	Percent of customers using parking		
	Parking only	Curb and parking	Total using parking
Departures	3%	19%	22%
Arrivals	10%	25%	35%

Table 7. Proportion of customers using parking

Most customers who use the parking lots in the Terminal 5/6 sector, park for a short period of time. As noted above, the median duration for hourly parking is 110 minutes, and this duration applies to the 78% of customers who park for less than one day. However, a subset of parkers leave their vehicles overnight, some for several nights. Using the customer intercept surveys, the following profile of overnight parking was developed. Because the overnight parking profile differs significantly between the morning departures peak and the rest of the day, two profiles were used in the subsequent parking demand modeling.

Number of nights	Percent of customers who use parking lots	
	Peak departures (6-10 a.m.)	*Off-peak departures (all other times)*
0 (hourly parking)	78.0 %	95.0 %
1	7.3 %	3.0 %
2	4.9 %	1.0 %
3	7.3 %	1.0 %
4	1.2 %	0 %
5+	1.2 %	0 %

Table 8 Distribution of overnight parking

4. CONVERTING CUSTOMERS TO LANDSIDE VEHICLE TRAFFIC

Customer-at-curb loads from the 26-gate jetBlue schedule were used to generate vehicles at curb in five-minute intervals for the entire planning day. The peak hour, in terms of customers entering/exiting Terminal 5, is from 18:45 to 19:45. During this hour, 3,624 customer enter or exit the building (2,020 arrivals and 1,604 departures). JetBlue customer volumes were converted to vehicles at curb using parameters observed in the field in Spring 2003, as previously discussed.

4.1 Vehicles at curb

The following table summarizes the vehicular traffic generated at Terminal 5 during the 18:45-19:45 peak hour. This peak drives the requirements for traffic capacity on landside roadways. In the following tables, "Customers" refers to originating/terminating customers who enter and exit the terminal. "Customers at curb" refers to the subset of the customers who use the curb frontages.

	Customer	Customers at curb	Vehicles at curb
Arrivals	2,020	1,495	709
Departures	1,604	1,267	795
Total	**3,624**	**2,762**	**1,504**

Table 9. Peak hour vehicles at curb

Within this peak hour, the peak 15 minute period occurs between 19:21 and 19:35, when 1,202 customers enter and exit the terminal. The following table summarizes the vehicular traffic generated at Terminal 5 during the peak 15 minutes.

	Customers	Customers at curb	Vehicles at curb
Arrivals	875	648	307
Departures	327	258	162
Total	**1,202**	906	**469**

Table 10. Peak 15 minute vehicles at curb

Two other peak hours are important for planning purposes – the individual arrivals peak and the individual departures peak. These peaks drive the sizing of the arrivals and departures curb frontages. They are described in the table below.

	Time of peak hour	Customer	Vehicles at curb
Arrivals	18:50 – 19:50	2,081	730
Departures	6:45 – 7:45	2,279	1,129

Table 11 Individual arrivals and departures peak hour volumes

While JetBlue parameters generate additional cars using the curb, the reduction in dwell time actually generates lower total demand. As summarized in the following table, using the PA standard parameters instead of the JetBlue observed parameters would decrease forecast departures curb requirements by 11% and arrivals curb requirements by 3%. The calculations using the JetBlue parameters are contained in Attachment A, while the comparable calculation using the PA parameters is Attachment B to this Appendix.

Sector	Peak Hour Vehicles at Curb		% Difference
	PA CTA	*JetBlue*	
Departures	1021	1129	11%
Arrivals	709	730	3%
Total	**1730**	**1860**	**8%**

Table 6. Vehicles at Curb in Peak Hour – Impact of using JetBlue vs PA Parameters

5. CURB FRONTAGE ANALYSIS

5.1 Summary

The following curb requirements have been calculated using the planning parameters and customer volumes described above.

Frontage	Modes served	Required Curb Length (ft)
Departures	**All modes – common curb**	725 [6]
Arrivals	Private vehicles	365 [7]
	For-hire vehicles	100 [8]
	Subtotal – common curbs	*465*
	HOV loading	105
	Taxi loading	150
	Total Arrivals	***720***

Table 12. Curb frontage requirements summary

[6] This is the actual frontage length needed, assuming that two stopping lanes are provided.
[7] See note 6.
[8] See note 6.

(Ex. 4)

Figure 2. Allocation of curb frontage space

5.2 Methodology

Curb requirements are calculated by determining the 90th percentile curb demand during the peak hour. This is calculated using the Poisson distribution, based on the average curb demand across the peak hour.

For multilane curbs, it is assumed that the second lane from the curb provides 30% of the capacity of the curbside lane. This applies only to the departures common curb and the arrivals private/for-hire common curb.

The following table summarizes the curb influence lengths assumed for each class of vehicle at Terminal 5.

Mode	Influence length (ft)
Private autos	25
Taxis	25
For hire vehicles	25
HOV (shuttles and buses)	55
AirTrain	N/A

Table 13. Vehicle curb influence lengths

The requirements for arrivals and departures frontages are based on peak hour traffic volumes to the curb. These are calculated as a function of:

- peak hour customer volumes (which take into account a customer arrival profile applied to the flight schedule) – see Section 2
- customer mode split, and
- vehicle occupancy.

This allows determination of the peak hour vehicle volume for each mode. Once this is known, the dwell time and influence length are applied to determine the total space-time (in terms of vehicle-minutes) that is used for each mode in the peak hour. Dividing this space-time by 60 yields the expected average number of vehicles using the curb at any one time in the peak hour.

Because vehicle traffic arriving at the curb is assumed to follow a random arrival process (any micropeaking caused by the schedule is smoothed out by randomness in driver behavior and volatility in traffic conditions approaching the airport), the Poisson distribution is used to determine the 90th percentile demand on the curbs. When each mode uses an assigned, separate frontage (as on the arrivals level curbs), the requirement for each mode is the amount of space needed to accommodate the mode's 90th percentile demand. When modes share a curb frontages (as on the departures level common curb), the frontage needs are found by first determining total demand across all modes, based on weighted average vehicle lengths and dwell times, and then applying the Poisson distribution to find the 90th percentile. The spreadsheet in Attachment A shows these calculations in detail.

6. PARKING ANALYSIS

6.1 Results

An hour-by-hour entry-exit analysis showed that a minimum of **1,581 parking spaces** are needed in the T5 sector to serve the 26-gate schedule. This accounts for the peak occupancy of 1,446 vehicles at 19:10, and a short-term parking inefficiency factor, *f*, of 0.80, which is described further in Section 6.2.2 below.

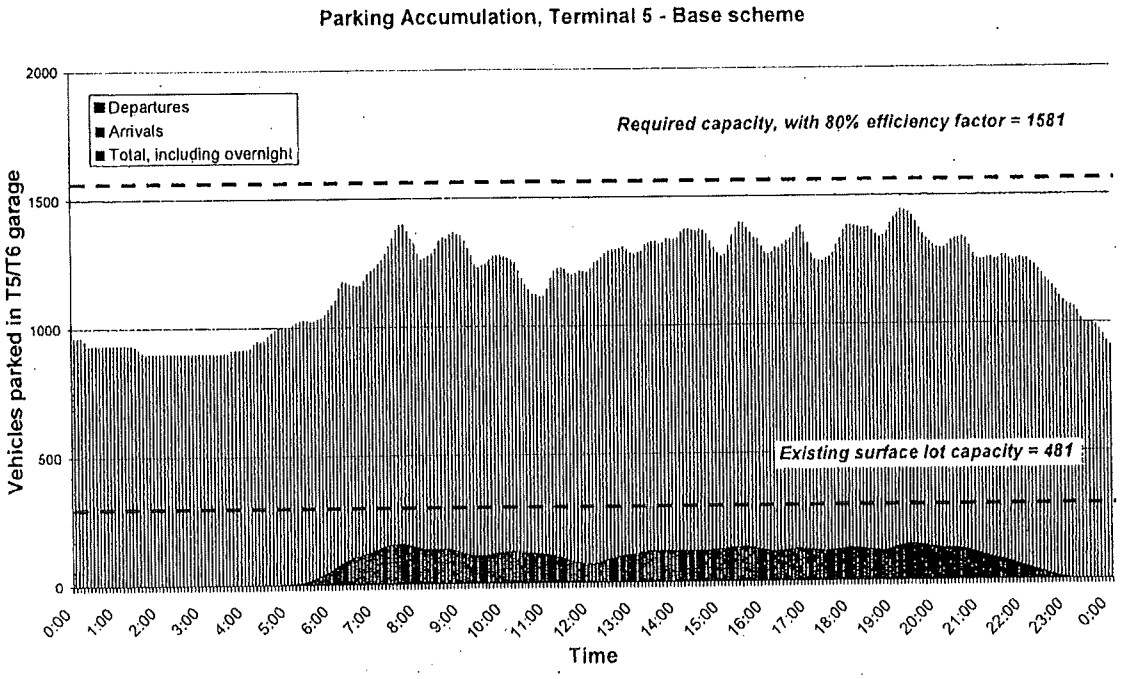

Figure 3. 24-hour parking accumulation pattern, Terminal 5

6.2 Methodology

6.2.1 Hour-by-hour Entry-exit analysis

A parking demand model was constructed to forecast public parking demand in the Terminal 5 sector, using the parameters described in Section 2 of the Terminal 5 Basis of Design report. The model was used to calculate the total number of vehicles that entered the parking garage based on departing and arriving customers at curb. It assumed that vehicles remained in the garage for 110 minutes (the median short-term parking duration observed at Terminal 6), and then exited. A running sum of the entries and exits gave the accumulation of short-term parking vehicles in the garage. The maximum accumulation is 543 short-term vehicles.

Overnight parking in the garage was accounted for by calculating the total daily number of overnight parking entries and multiplying by their length of stay in days. This gave the total number of overnight vehicles in the garage. The total number of vehicles in the garage at the peak was the sum of the variable hourly parking accumulation and the lump sum of overnight parking vehicles. The maximum accumulation is 902 overnight vehicles.

6.2.2 Parking inefficiency

For the purposes of calculating parking capacity requirements, it is assumed that in peak hours 80% of the parking spaces in the garage will be full. This is done by applying an inefficiency factor, *f*, to convert the peak short-term vehicle occupancy (in this case, 543 vehicles), to the peak space requirement to serve these vehicles (in this case, 679 spaces).

The value of *f* is typically set to 0.80 for multistory parking garages like the one proposed for the Terminal 5 landside. It is consistent with the PA's observation of other parking

garages in the CTA, including the Blue Garage. Because parking inefficiency stems from short-term parkers entering and leaving spaces in the lot, the factor is applied only to short-term vehicle, not long-term vehicles.

6.2.3 Volumes for analysis of components of the parking garage

Subsequent analysis (August 2005) of Port Authority Revenue Control System (RCS) data showed that the actual current turnover rate in the Yellow/Blue sector is 34.7%, meaning that 34.7% of all existing parking spaces are vacated each hour. To be conservative, this figure should be used as the design turnover rate. In order to size the elements of the parking deck that are impacted most heavily by turnover – drive aisles, floor-to-floor ramps, turning bays, ticket spitters, traffic conflict points, and internal intersections – should be sized using a traffic flow of 549 vehicles per hour (1,581 peak spaces required x 34.7% turnover).

7. INTERSECTION OPERATIONS

This section describes the modeling of constrained intersections in the Terminal 5/6 sector once a 26-gate Terminal 5 is operating. A Highway Capacity Manual analysis of the most constrained intersection, Intersection 51, was undertaken to determine how much vehicle traffic could be accommodated at Terminal 6 once the traffic forecasted at Terminal 5 is using the intersection. This vehicle traffic is converted back to customers at gate using the parameters described in Section 3.

7.1 Key intersections in T5/T6 sector

Regardless of landside improvements at Terminal 5, three locations on the existing landside at Terminal 6 will constrain the sector's ability to sustain traffic growth. These are shown in Figure 4 below. This section discusses how the expected traffic generated by Terminal 5 will impact traffic operations at these locations.

7.1.1 Intersection 51

Intersection 51 will serve all traffic exiting Terminals 5 and 6.

7.1.2 Intersection 42

Intersection 42 will serve traffic approaching Terminal 6, traffic exiting the Saarinen building frontage, and traffic exiting both arrivals and departures frontages at Terminal 5.

7.1.3 Sector exit roadway

This two-lane underpass carries all Terminal 5 and 6 exit traffic under the Terminal 7 approach roadway.

(Ex. 4)

Figure 4. Location of key landside traffic constraints

7.2 Sources of approach traffic

The approach volumes used to analyze the traffic operations at these intersections are consistent with other analyses described in this report. The peak hour for landside traffic is the 18:45-19:45 combined peak hour described in Table 9 above.

7.2.1 Curbs

Volumes entering and exiting each curb frontage are based on the calculations of curb traffic, as described in Section 5 above. During the peak hour, **1,504 vehicles** approach Intersections 42 and 51 from the Terminal 5 frontage – 709 from the arrivals frontage and 795 departures frontage.

7.2.2 Parking

As described above, RCS data for the Yellow/Blue sector reveals an hourly parking turnover rate of 34.7%. Based on this rate, the 1,581-space garage will see **549 vehicles** exit in the peak hour.

7.2.3 Saarinen building assumptions

While the future programming of the Saarinen building is not known at this time, its surface parking capacity is shown as 51 spaces in the current master plan scheme. It is assumed conservatively that **51 vehicles** will approach Intersections 42 and 51 in the peak hour from the Saarinen lot.

7.2.4 Recirculation traffic

Because the entry and exit ramps from the new Terminal 5 parking garage will be located upstream of Intersection 51, vehicles that recirculate between the garage and the terminal frontage will only pass through Intersection 51 once, when they exit the sector. This will be true whether the vehicles' traffic pattern is park-terminal-exit, or terminal-park-exit.

However, because the exit ramp is located upstream of Intersection 42, recirculation traffic between the garage and terminal will pass through this intersection twice.

These patterns were accounted for in the HCM intersection analysis.

7.3 Intersection operations – constraints on Terminal 6 traffic growth

If Terminal 6 remains in operation when the 26-gate Terminal 5 opens, landside traffic will constrain the number of peak hour customers that can be accommodated at Terminal 6.

With both Terminal 6 and 26-gate Terminal 5 operating, the constraint will be at Intersection 51. Intersection 51 is the three-legged intersection downstream of the Terminal 6 frontages. This intersection currently consists of two-lane approaches from Terminal 6 arrivals, Terminal 6 departures, and Terminal 5. Any of these approaches could be increased to three lanes, though this would necessitate also widening the underpass further downstream which carries traffic out of the Terminal 5/6 sector under the Terminal 7 entry road.

The table below shows the number of customers that could be accommodated at Terminal 6 under various scenarios for realigning Intersection 51. The scenario names refer to the number of lanes on the Terminal 6 arrivals, Terminal 6 departures, and Terminal 5 roads, respectively. All scenarios assume that Terminal 5 traffic is held constant at the level generated by the 26-gate schedule. The volumes shown at Terminal 6 are the maximum volumes possible if LOS C operations and a standard 90-second cycle are to be maintained. Adding more customers than shown in the table below will cause Intersection 51 to operate below LOS C. All of these scenarios except "Base" would require widening the underpass beneath the Terminal 7 entry road.

Vehicle movement	Base (222)		223		323		333	
	Veh	Pax at curb	Veh	Pax at curb	Veh	Pax at curb	Veh	Pax at curb
T5 exits (based on planning schedule)[9]	2,053 (2 lanes)	3,624	2,053 (3 lanes)	3,624	2,053 (3 lanes)	3,624	2,053 (3 lanes)	3,624
T6 departures	24 (2 lanes)	41	156 (2 lanes)	270	141 (2 lanes)	244	238 (3 lanes)	413
T6 arrivals	24 (2 lanes)	59	156 (2 lanes)	391	211 (3 lanes)	529	238 (3 lanes)	597
T6 total (maximum flow possible at LOS C)	48	100	312	661	352	773	476	1,010
T5/T6 Sector total	2,101	3,724	2,365	4,285	2,405	4,397	2,529	4,634
Requires widening of sector exit roadway?	No		Yes		Yes		Yes	

Table 14. Summary of traffic constraints on Terminal 6 under the current configuration of Intersection 51

DEPARTURES CURB FRONTAGE: JetBlue 26-gate T5 Schedule

PARAMETERS OBSERVED AT TERM 6, 2003 (during arrivals peak hour, 18:50-19:50)

Total Passengers (at curb):	2279
Interlining:	0
Originating:	2279

Mode	Mode Split		Pax By Mode		Pct Pax Using Curb		Pax Using Curb	Total Pax @ Curb	Occupancy	Vehicles	Re-circulation	Vehicle Mode Split	Dwell	Weighted Dwell	Space	90% Peak Spaces Req	Influence Length	Weighted Influence	Required Frontage
LOV	Originating	Interlining	Originating	Interlining	Originating International	Originating Domestic	Originating		Pax per vehicle										
Auto	30%	0%	684	0	100%	97%	663	663	1.20	553	553	53.7%	1.3	0.698	12.0	16	25	13.4	400
Taxi	14%	7%	319	0	100%	100%	319	319	1.36	235	235	22.8%	0.9	0.213	3.6	6	25	5.7	150
For Hire	16%	0%	365	0	100%	100%	365	365	1.51	241	241	23.5%	1.9	0.442	7.6	11	25	5.9	275
Rental Car	0%	0%	0	0	100%	100%	0	0	2.00	0	0	0.0%	1.0	0.000	0.0	0	25	0.0	0
Sub LOV (seg)	*60%*	*7%*	*1367*	*0*			*1347*	*1347*		*1029*	*1029*	*100.0%*		*1.353*				*25.0*	*825*
Common													*Common*		*23.2*	*29*			*725*
HOV																			
LRS	21%	93%	479	0	0%	0%	0	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Shuttles	19%	0%	433	0	100%	100%	433	433	4.30	101	101	100.0%	2.2	2.205	4.0		35	35.0	140
Off-Airport (Transi	0%	0%	0	0	100%	100%	0	0	0.00				0.0	0.000	0.0		55	0.0	0
Sub HOV (seg)	*40%*	*93%*	*912*	*0*			*433*	*433*		*101*	*101*	*100.0%*		*2.205*				*35.0*	*140*
Common													*Common*		*4.0*				*220*
Total	*100%*	*100%*	*2279*	*0*			*1780*	*1780*	*Used mean, not low-bound 95% CI for shuttles*									*55.0*	

Linear Length Required Common Curb: Los A *945*

Linear Length Required Common Curb: Los C *727*

ARRIVALS CURB FRONTAGE: JetBlue 26-gate T5 Schedule

PARAMETERS OBSERVED AT TERM 6, 2003

Total Passengers (at curb):	2081
Interlining:	0
Terminating:	2081

Mode	Mode Split		Pax By Mode		Pct Pax Using Curb		Pax Using Curb	Total Pax @ Curb	Occupancy	Vehicles	Re-circulation	Vehicle Mode Split	Dwell	Weighted Dwell	Space	90% Peak Spaces Req	Influence Length	Weighted Influence	Required Frontage
LOV	Terminating	Interlining	Terminating	Interlining	Terminating International	Terminating Domestic	Terminating		Pax per vehicle										
Auto	46%	0%	957	0	100%	90%	862	862	1.86	463	463	71.2%	1.8	1.312	14.2	19	25	17.8	475
Taxi	10%	7%	208	0	100%	100%	208	208	1.67	125	125	19.2%	1.6	0.298	3.2	6	25	4.8	150
For Hire	12%	0%	250	0	100%	50%	125	125	2.00	62	62	9.6%	3.0	0.290	3.1	5	25	2.4	125
Rental Car	0%	0%	0	0	100%	100%	0	0	2.00	0	0	0.0%	1.0	0.000	0.0	0	25	0.0	0
Sub LOV (seg)	*68%*	*7%*	*1415*	*0*			*1194*	*1194*		*650*	*650*	*100.0%*		*1.901*				*25.0*	*750*
															17.4	*23*			*575*
HOV																			
LRS	26%	93%	541	0	0%	0%	0	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Shuttle	6%	0%	125	0	100%	100%	125	125	1.56	80	80	100.0%	2.0	1.997	2.7		35	35.0	105
Off-Airport (Transi	0%	0%	0	0	100%	100%	0	0	10.00	0	0	0.0%	1.0	0.000	0.0		55	0.0	0
Sub HOV (seg)	*32%*	*93%*	*666*	*0*			*125*	*125*		*80*	*80*	*100.0%*		*1.997*					*105*
Total	*100%*	*100%*	*2081*	*0*			*1319*	*1319*											

Linear Length Required for Private, For-hire: LOS A *575*

Linear Length Required for Private, For-hire: LOS C *442*

NOTES:

1. *Above analysis assumes Schedule Bus/Van/Limo are demand driven whereas they are actually schedule driven*
2. *Above analysis assumes Arrival Taxis are demand driven whereas they have different operational characteristics*
3. *Courtesy Vehicles are not included in above analysis*
4. *Above analysis assumes Off-Airport (Transit) Buses are demand driven whereas they are actually schedule driven*
5. *Above analysis assumes all departures HOV goto arrivals frontage*

Taxis:	*150*
Scheduled Bus/Van/Limo	*140*
Off-Airport Bus:	*0*
Total Required:	*732*

DEPARTURES CURB FRONTAGE: JetBlue 26-gate T5 Schedule
PORT AUTHORITY CTA PARAMETERS

Total Passengers (at curb) =	2279
Interlining	0%	0
Originating	100%	2279

Mode / LOV	Mode Split Originating	Mode Split Interlining	Pax By Mode Originating	Pax By Mode Interlining	Pct Pax Using Curb Originating International	Pct Pax Using Curb Originating Domestic	Pax Using Curb Originating	Total Pax @ Curb	Occupancy Pax per vehicle	Vehicles	Re-circulation	Vehicle Mode Split	90% Dwell	Weighted Dwell	Space	90% Peak Spaces Req	Influence Length	Weighted Influence	Required Frontage
Auto	37%	0%	843	0	100%	76%	641	641	1.50	427	427	45.5%	3.3	1.500	23.5	30	25	11.4	750
Taxi	18%	7%	410	0	100%	100%	410	410	1.50	273	273	29.1%	1.4	0.407	6.4	10	25	7.3	250
For Hire	14%	0%	319	0	100%	90%	287	287	1.20	239	239	25.5%	2.9	0.738	11.6	16	25	6.4	400
Rental Car	0%	0%	0	0	100%	100%	0	0	2.00	0	0	0.0%	1.0	0.000	0.0	0	25	0.0	0
Sub LOV (seq)	*69%*	*7%*	*1573*	*0*			*1338*	*1338*		*940*	*940*	*100.0%*		2.645				*25.0*	*1400*
													Common		*41.4*	50			*1250*
HOV																			
LRS	15%	93%	342	0	0%	0%	0	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Shuttles	16%	0%	365	0	100%	100%	365	365	4.50	81	81	100.0%	1.8	1.800	2.0		35	35.0	70
Off-Airport (Transi	0%	0%	0	0	100%	100%	0	0	0.00		0		0.0	0.000	0.0		55	0.0	0
Sub HOV (seq)	*31%*	*93%*	*706*	*0*			*365*	*365*		*81*	*81*	*100.0%*		*1.800*				*35.0*	*70*
Common													*Common*		*2.0*			*55.0*	*110*
Total	*100%*	*100%*	*2279*	*0*			*1703*	*1703*	*Used mean, not low-bound 95% CI for shuttles*										

Linear Length Required Common Curb: Los A *1360*
Linear Length Required Common Curb: Los C *1046*

ARRIVALS CURB FRONTAGE: JetBlue 26-gate T5 Schedule
PORT AUTHORITY CTA PARAMETERS

Total Passengers (at curb) =	2081
Interlining	0%	0
Terminating	100%	2081

Mode / LOV	Mode Split Terminating	Mode Split Interlining	Pax By Mode Terminating	Pax By Mode Interlining	Pct Pax Using Curb Terminating International	Pct Pax Using Curb Terminating Domestic	Pax Using Curb Terminating	Total Pax @ Curb	Occupancy Pax per vehicle	Vehicles	Re-circulation	Vehicle Mode Split	90% Dwell	Weighted Dwell	Space	90% Peak Spaces Req	Influence Length	Weighted Influence	Required Frontage
Auto	37%	0%	770	0	100%	50%	385	385	1.50	257	257	40.9%	3.3	1.349	14.1	19	25	10.2	475
Taxi	18%	7%	375	0	100%	100%	375	375	1.50	250	250	39.8%	1.4	0.557	5.8	9	25	9.9	225
For Hire	14%	0%	291	0	100%	50%	146	146	1.20	121	121	19.3%	2.9	0.561	5.9	9	25	4.8	225
Rental Car	0%	0%	0	0	100%	100%	0	0	2.00	0	0	0.0%	1.0	0.000	0.0	0	25	0.0	0
Sub LOV (seq)	*69%*	*7%*	*1435*	*0*			*905*	*905*		*628*	*628*	*100.0%*		*2.467*				*25.0*	*925*
															20.0	26			*650*
HOV																			
LRS	15%	93%	312	0	0%	0%	0	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Shuttle	16%	0%	333	0	100%	100%	333	333	4.50	74	74	100.0%	1.8	1.800	2.2		35	35.0	105
Off-Airport (Transi	0%	0%	0	0	100%	100%	0	0	10.00	0	0	0.0%	1.0	0.000	0.0		55	0.0	0
Sub HOV (seq)	*31%*	*93%*	*645*	*0*			*333*	*333*		*74*	*74*	*100.0%*		*1.800*					*105*
Total	*100%*	*100%*	*2081*	*0*			*1238*	*1238*											

Linear Length Required for Private, For-hire: LOS A *650*
Linear Length Required for Private, For-hire: LOS C *500*

NOTES:
1. *Above analysis assumes Schedule Bus/Van/Limo are demand driven whereas they are actually schedule driven*
2. *Above analysis assumes Arrival Taxis are demand driven whereas they have different operational characteristics*
3. *Courtesy Vehicles are not included in above analysis*
4. *Above analysis assumes Off-Airport (Transit) Buses are demand driven whereas they are actually schedule driven*
5. *Above analysis assumes all departures HOV goto arrivals frontage*

Taxis: *225*
Scheduled Bus/Van/Limo *105*
Off-Airport Bus: *0*
Total Required: *830*

Volumes generated with...

Departures vehicles at curb

Vehicle class	JetBlue parameters	CTA parameters	Difference	Pct difference
Auto	553	427	-125	-23%
Taxi	235	273	39	17%
For Hire	241	239	-2	-1%
Shuttles	101	81	-20	-20%
Total	1129	1021	-108	-10%

Arrivals vehicles at curb

Vehicle class	JetBlue parameters	CTA parameters	Difference	Pct difference
Auto	463	257	-207	-45%
Taxi	125	250	125	100%
For Hire	62	121	59	94%
Shuttles	80	74	-6	-8%
Total	730	702	-29	-4%

Grand total	**1860**	**1723**	**-137**	**-7%**

Appendix C

Terminal Capacity Analysis

jetBlue
AIRWAYS

JFK International Airport Terminal 5 Redevelopment

Basis of Design Appendix C : Terminal Capacity Analysis

ARUP
Design Manager

Gensler
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1. INTRODUCTION

In 2003, Arup undertook a comprehensive analysis of the functional requirements for a new Terminal 5 at JFK for JetBlue. The results of that analysis were used to generate a program of processing requirements which has been used as the basis for design.

In December 2004, Arup updated the simulation model using the current design drawings. The objective of this analysis was to confirm the level of service provided, and that the proposed layout will meet the JetBlue standards for terminal operations and customer service, comfort and satisfaction.

1.1 Issues addressed in this report

This report addresses the following terminal planning issues:

- Demand
- Planning parameters
- Processing Requirements Summary
- Current Design Level of Service Performance
- Egress Requirements

The current design performance was evaluation through a simulation model. A CD containing schematic animations of the simulated processes accompanies this report.

2. DEMAND

The planning day schedule (see BoD Appendix A) is for 248 flights in each direction. This schedule consists of A320 and EMB190 flight movements. While the planning schedule has remained constant throughout the planning process, minor changes in aircraft seat capacity have made reference to load factor obsolete. The following table contains the enplaning/deplaning and originating/terminating customer loads used in the planning schedule. Note that the transfer percentage, and therefore the originating/ terminating volumes, varies by time of day.

Planning Day Schedule Customer Volumes					
Aircraft	Enplaning & Deplaning	Originating & Terminating			
	All Day	Early AM*	AM/PM	Late PM	Latest PM
A320	146	131	117	131	146
EMB190	80	72	64	72	80
Early AM is departures before 9:05 and arrivals before 8:25 AM/PM is departures 9:06-21:29 and arrivals 8:26-20:25 Late PM is departures after 21:30 and arrivals 20:26-22:30 Latest PM is arrivals after 22:30					

Table 1: Planning Day Schedule Customer Volumes

Specific traffic parameters associated with the planning day schedule include:

- Daily Arrivals: 23,240 customers on 248 flights
- Daily Departures: 23,240 customers on 248 flights
- Peak Hour Arrivals (Terminating): 1,970 customers on 20 flights (18:30-19:30)
- Peak Hour Departures (Originating): 2,625 customers on 25 flights (07:45-08:45)
- Additional average 20% transfer customers (varies by time of day)
- Additional 20% wellwishers & greeters

The preceding peak hour volumes are based on flight arrival and departure times. The following are the peak hour volumes of originating/terminating customers entering and exiting the terminal:

Peak Hour Terminating Customers Exiting Terminal: 2,081 (18:50-19:50)

Peak Hour Originating Customers Entering Terminal: 2,279 (6:45-7:45)

The distribution of terminating customers exiting the terminal after arriving on a flight is determined by the interaction of a number of factors including: walking speed, checked baggage characteristics and baggage system performance. As such, this is an output rather than an input to the simulation model used in this analysis.

The following distribution was used to generate the volume of customers entering the terminal.

Originating Customer Arrival at Terminal	
Time prior to scheduled flight departure (minutes)	**Percentage of originating customers entering the terminal**
150-120	2
120-100	5
100-80	12
80-60	22
60-40	38
40-20	21
20-0	0
Total	**100%**

Table 2: Originating Customer Arrival at Terminal

3. PLANNING PARAMETERS

3.1 Departing Customer Processing Assumptions

3.1.1 AirTrain Connector

28% of all originating customers (21% AirTrain Users and 7% to parking) – including associated wellwishers – are assumed to arrive at the terminal through the AirTrain connector. In addition, all well-wishers are assumed to leave the terminal through the AirTrain connector.

3.1.2 Check-In Processing

The check-in split can be summarized as follows:

- 60% of customers use the automated kiosks
  - 35% of customers will have no bags and will use automated kiosks with no adjacent bag drop.
  - The remaining 25% of customers will use the self-service check-in with bag drops.
- 10% of customers to curb.
- 30% of customers to full-service counters.

Customers are assumed to be split equally between the North and South check-in areas.

The check-in areas noted above have the following processing rates:

	Servers	Mean processing rate (min/customer)
Curb	12	2.0
Lobby	28	2.0
Kiosk No Bags	16	1.0
Kiosk With Bags	24	1.5

Table 3: Check-In Processing Rates

3.1.3 Security Screening

In 2003, the Program of Requirements for the design of the new T5 assumed a processing rate at the security checkpoint of 140 customers per lane per hour (cplph) as indicated by surveys taken at that time.

JetBlue carried out extensive surveys of security at Terminal 6 (T6) at the end of June and in early July 2004. Observed non-selectee security processing rates on the west side of T6 tended to be faster than on the east side at 243 customers per lane per hour (cplph) as compared to 189 cplph. For consistency with the previous work, the rate of 140 cplph was used in this analysis. This conservative rate provides an evaluation of the security checkpoint capability under a worst-case scenario.

20 security lanes are provided in the proposed layout. Of these, one is reserved for the processing of flight crews, 5 are used for the more thorough screening of selectee customers, and the remaining 14 are used for non-selectee customers.

3.1.4 Concessions

All customers who clear security with less than 20 minutes to flight departure time proceed directly to the gate. The others are split as follows:

- 35% of customers are assumed to proceed directly to the gate without making use of any kind of concessions.
- 42% of customers are assumed to make use of the concessions located in the central area close to the security checkpoint exit.
- The remaining 23% of customers proceed to the concessions areas located in the concourses from which they are departing.

The time customers spend at concessions is dependent upon the discretionary time they have available, but no customer spends more than 60 minutes at concession and no customer will leave concessions for the gate with less than 20 minutes to flight departure time.

3.1.5 Holdrooms

The majority of the new T5 holdrooms were designed to be shared by two or more gates, allowing for a smaller total holdroom footprint while maintaining a high level of service. In this analysis, a total of ten holdrooms were considered, with the following allocation to gates (note that there is no Gate 13):

Holdroom	Gates Served
1	1-6
2	7
3	8-9
4	10-11
5	12-14
6	15-17
7	18-19
8	20-21
9	22-24
10	25-27

Table 4: Allocation of Holdrooms to Gates

3.2 Arriving Customer Processing Assumptions

3.2.1 Baggage and Greeters

65% of the terminating customers are assumed to have checked baggage.

The greeters/customer ratio is assumed to be 0.2.

The delivery of the first bag at the carousel is assumed to be 7 minutes after flight arrival at the gate. A constant unloading rate of 25 bags/min was used. That represents two baggage crewmembers unloading the carts at a rate of 12.5 bags/min.

Depending on walking speed and gate location, individual customers can arrive before any bags, after all bags, or while bags are being dispensed. A matching algorithm is used to determine how long each customer waits before they are able to retrieve their bags. It is assumed that all customers will retrieve there bags on the first or second circulation, once both the customer and the bag are at the bag claim carousel.

3.2.2 Exit Ramp Usage

Terminating customers with no checked baggage and no greeters may choose to exit the gate area through the exit ramp adjacent to the security checkpoint and access the AirTrain connector through the departures level. In this analysis, it is assumed that 50% of such customers will make that choice. The remainder will proceed down to the baggage claim area and then to the curb.

3.2.3 AirTrain Connector Usage

All greeters access the terminal through the AirTrain connector. 42% of all terminating customers (26% AirTrain Users and 16% to parking) – including all associated greeters – are assumed to leave the terminal through the AirTrain connector.

3.2.4 Center-Processor Elevators

It is assumed that the primary users of the Center-Processor elevators are wheelchair customers who are unable to use the adjacent bank of escalators. In addition to wheelchair users, 25 percent of terminating customers with bags has been sent to these elevators.

4. SIMULATION RESULTS

A simulation model was built using Arena to simulate the customer flows and their associated well-wishers and greeters. Seven iterations of the model were run for statistical validity. Following are the maximum results of the simulations.

4.1 Departures

4.1.1 Processing

Table 4 below summarizes the findings for the customer processing facilities. The values for processes that are split into two locations (e.g., North and South processor) are shown with a plus ("+") sign.

Throughout the check-in and security check facilities, waiting times are projected at under 2.5 minutes and queue lengths can be readily accommodated within the space provided, resulting in a very high level of service to customers. It should be noted that the simulation assumes full-staffing of all positions throughout the planning day.

	Servers	Max. Queue	Capacity	Max Wait (min)	Avg Wait (min)
Kiosk Checkin (no bags)	16	8	-	0.4	0.0
Kiosk Checkin (bags)	12+12	10+10	50+50	1.2	0.0
Full-Service Counter Checkin	14+14	14+14	100+100	1.8	0.0
Curb Checkin	6+6	8+8	-	2.3	0.0
Non-Selectee Checkpoint	7+7	40+40	175+175	2.4	0.1
Selectee Checkpoint	5	10	125	1.5	1.5

Table 5: Maximum queues at Customer Processing Facilities

4.1.2 Holdrooms

The latest IATA Airport Development Reference Manual (January 2004), recommends providing capacity based on 80% seated at 18.3 sf per person and 20% standing at 12.9 sf per person. This is considered to be Level of Service C. Table 5 compares the maximum occupancies in each holdroom area to the capacity calculated on this basis. In all cases, the simulated occupancies are below the capacity of the holdrooms, providing an excellent level of customer service.

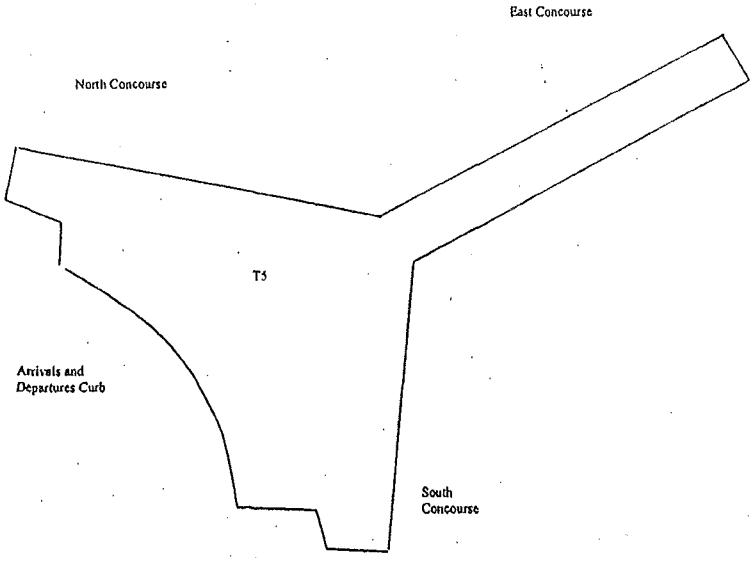
	Maximum Occupancy	Capacity
Gates 1-6	468	560
Gate 7	127	162
Gates 8-9	201	253
Gates 10-11	219	268
Gates 12-14	173	245
Gates 15-17	265	354
Gates 18-19	236	269
Gates 20-21	214	230
Gates 22-24	279	450
Gates 25-27	332	335

Table 6: Maximum Holdroom Occupancies

4.1.3 Concessions

	Maximum Occupancy
Central	683
South Concourse	117
North Concourse	123
East Concourse (gates 9-10)	108
East Concourse (gates 11-12)	110

Table 7: Maximum Concessions Occupancies



Key diagram

4.1.4 Circulation

Table 8 summarizes the maximum 5-minute customer flows within the concourses. The north and south concourses each have a circulation corridor of 20 feet. The maximum bi-directional flow in these concourses is 212 customers in a 5 minute period. This equates to a demand of 3 customers/minute/foot (after deduction for edge-effect). The east (center) concourse, with a circulation corridor width of 30 feet, has a maximum bi-directional flow of 291 customers, which equates to approximately 2.5 customers/minute/foot (after deduction for edge-effect). Based on Fruin, all of these circulation areas provide an excellent customer experience operating at level of service A, (the upper limit of which is 7 customers/minute/ foot.)

The central area flow-through used by all arriving and departing customers has a peak bi-directional flow of 428 customers. This equates to a corridor width requirement of approximately 13 feet. While designs for this area are still being fine-tuned, all of the options under examination propose widths in excess of this demand, resulting in a very good level of customer service (Level of Service C or better).

North Concourse	Maximum 5-minute flow	Time	Opposite flow at peak
Inbound	122	19:30	55
Outbound	74	6:40	0
Bi-directional	177	19:30	-
East (Center) Concourse			
Inbound	209	12:35	62
Outbound	138	6:40	0
Bi-directional	291	10:20	-
South Concourse			
Inbound	159	19:40	53
Outbound	72	6:40	0
Bi-directional	212	19:40	-
Central area (flow-through)	428	19:35	-

Table 8: Maximum Customer Flows within the Concourse

4.2 Arrivals

4.2.1 Baggage Claim

Table 9 shows the occupancies at the baggage carousels. The maximum occupancy is projected to be significantly less than the carousels' capacity at LOS C, according to current IATA standards (18.3 sf per person for the "retrieval and peripheral area" surrounding each carousel). A number of sensitivity tests using various bag arrival rates has been tested and the level of service remains good.

	Maximum Occupancy	Capacity at LOS C
Carousel 1	80	186
Carousel 2	82	186
Carousel 3	83	186
Carousel 4	79	186
Carousel 5	77	186
Carousel 6	82	186

Table 9: Maximum Bag Carrousel Populations

4.2.2 Circulation

The customer flows on the corridors behind the baggage claim devices was measured at their entrances, where they are most critical. Table 10 shows the maximum 5-min flows that occurred during the simulation. These figures are consistent with LOS A, based on Fruin's standards for passageways and corridors, taking into account an edge-effect of 3 feet (1.5 feet on either side).

Baggage Claim	Maximum 5-minute flow
North	108
South	116
Exit ramp	43

Table 10: Maximum flows behind the baggage carrousels

4.2.3 Vertical Circulation Elements

The following table summarizes the maximum queues and wait times associated with the various vertical circulation elements in the public area.

	Servers	Maximum Queue	Maximum Wait (minutes)
Elevators departures to bag claim	2	3	0.5
Escalators departures to bag claim	1	0	0.0
Elevators up to departures	2	18	1.2
Escalator to departure	1	6	0.1

Table 11: Maximum flows at Vertical Circulation

Sufficient space is provided to ensure that Level of Service C or better is available in the queuing areas.

4.3 AirTrain Connector

The maximum population observed in the connector at any point in time was 209 people, which can be accommodated at a good level of service. No flow issues were identified.

5. EGRESS REQUIREMENTS

The majority of this report addresses the performance of the terminal under normal operating conditions. This sections deals with emergency egress requirements.

The BCCNY uses the unit width concept, in which a unit has a width of 22 inches and a half unit is 12 inches. The code specifies the number of people that a unit can accommodate based on occupancy. Egress components are generally rounded to the higher half unit. According to the BCCNY, the terminal's major occupancy classification would be F-3 Assembly. As such, the egress requirements of subchapter 8 are applicable in conjunction with the requirements of subchapter 6.

Subchapter 6 provides the general requirements for egress components and occupant load factors. In general the occupant load factors required by the BCCNY result in higher occupant loads than the IBC. Subchapter 8 provides the egress width per unit for assembly occupancies. Doors and stairs for F-3 occupancy accommodate 80 people per unit width (Table 8-1). Also, the BCCNY requires travel distance to be limited to 150 feet to the primary exit and 187 feet to a secondary exit in sprinklered facilities. Section 27-533 provides specific direction and penalties that must be accounted for when measuring travel distance.

Table 1 and 2 below provide the occupant loads based on BCCNY for the planning drawings.
Several methods were utilized in calculating occupant load for the terminal building. Based on PANYNJ Tenant Construction Review Manual egress must be sized for a minimum of a 2 hour delay of flights and/or the BCCNY A summary of calculation methods and key results follow:

1. The total occupant load for the building using the BCCNY load factors is 18,307 occupants. This results in a requirement for approximately 230 units (422 feet) of egress width to be provided throughout the building.
2. The peak hour plus 2-hour delay (3 hour delay) occupant load based on projected ridership data results in 14,320 passengers, meeters and greeters. Adding in support spaces (~2350 occupants) results in a total occupant load of 16,670.
3. The peak hour plus 1 hour delay (2-hour delay) results in a calculated occupant load of 13,120, inclusive of occupants located in support spaces.

The BCCNY provides the most restrictive requirement and would provide enough egress to meet the 2 hour delay component.

jetBlue Airways Corporation Level 1				
Space Designation	Occupancy	Area	OLF	Occupants
Facility Maintenance	B-2	10789	100	108
Docks	B-2	4068	200	21
Restroom	accessory	894	100	9
Retail Concession	C	3157	25	127
Concession Storage	B-2	12149	200	61
MEP	B-2	7693	200	39
Cabin Cleaning	E	2419	100	25
Customer Service	E	4298	100	43
Corp Sec	E	1287	100	13
Skycap	E	2343	100	24
Janitorial	B-2	1918	200	10
Ramp Services	E	4569	100	46
Customer Service	F-3	741	4	186
Customer Service	F-3	741	4	186
Retail Concession	C	2450	25	98
Restroom	accessory	894	100	9
Facility Maintenance	B-2	2643	200	14
Janitorial	B-2	4151	200	21
Concession	C	4637	25	186
System Operations	E	6788	100	68
Checkpoint security	F-3	3372	100	34
Public/Passenger Circulation	F-3	86462	20	4324
Flight Operations	E	14287	100	143
Inflight Services	E	14911	100	150
People Dprt	E	4853	100	49
Ramp Services	E	4570	100	46
IT	E	4837	100	49
MEP	B-2	14271	200	72
Crew Services	E	1945	100	20
Fueling	A	100	200	1
Provisions/AC Catering	E	220	100	3
Baggage Circulation	F-3	22241	300	75
MEP	B-2	6680	200	34
EDS	B-2	20841	200	105
MEP	B-2	1863	200	10
Ramp Services	E	7046	100	71
Aircraft Maintenance	B-2	6642	100	67
Baggage Circulation	B-2	22241	200	112
Technical Standards	E	296	100	3
			Subtotal	6662

Table 12: Level 1 Occupant Load (BCCNY)

jetBlue Airways Corporation Level 2				
Space Designation	**Occupancy**	**Area**	**OLF**	**Occupants**
Rest Room	accessory	1267	100	13
Retail Concessions	C	1751	25	71
Loading Docks	B-2	387	200	2
Rest Room	accessory	1346	100	14
Retail Concessions	C	2279	25	92
Holdroom	F-3	13916	15	928
ATO Customer Service	E	5345	100	54
Janitorial	B-2	1053	200	6
Airside Customer Services	E	421	4	106
Rest Room	accessory	1008	100	11
Landside/ATO Customer Services	F-3	937	4	235
Baggage Circulation	F-3	573	20	29
Landside/ATO Customer Services	F-3	937	4	235
Baggage Circulation	F-3	573	20	29
Baggage Circulation	F-3	657	20	33
Retail Concessions	C	7845	25	314
Retail Concessions	C	7978	25	320
Holdroom	F-3	9153	15	611
Holdroom	F-3	4885	15	326
ATO Customer Service	E	4543	100	46
Rest Room	accessory	995	100	10
Checkpoint Security	F-3	352	15	24
Skycap/wheelchair Services	E	459	100	5
Airside Customer Services	E	421	15	29
Rest Room	accessory	916	100	10
Retail Concessions	C	744	25	30
ATO Customer Service	E	428	15	29
Retail Concessions	C	9665	25	387
Public/Passenger Circulation	F-3	128593	100	1286
Ticketing Queuing	F-3	8100	4	2025
Security Queuing	F-3	4725	4	1182
Retail Concessions	C	9298	25	372
Checkpoint Security	F-3	352	15	24
Holdroom	F-3	7651	15	511
Rest Room	accessory	1176	100	12
Retail Concessions	C	2352	25	95
Holdroom	F-3	22163	15	1478
Rest Room	accessory	1176	100	12
Retail Concessions	C	2352	25	95
Holdroom	F-3	7531	15	503
Facility Maintenance	B-2	472	200	3
Provisions/AC Catering	E	240	100	3
Airside Customer Services	E	661	15	45
			Subtotal	**11645**

Table 13:Level 2 Occupant Load (BCCNY)

6. CONCLUSIONS

This analysis has evaluated the performance of all relevant customer-processing areas and amenities as set out in the proposed design for the new Terminal 5 under specific operational assumptions and using the peak period planning schedule. This simulation relies on full staffing of all facilities by JetBlue and the TSA, as required. In addition, this analysis has not considered IROP (Irregular Operating) conditions. Under the conditions considered in this analysis, all processors are shown to operate at a high level of service, providing fast service at the processors and high levels of comfort in circulation and holding areas.

Appendix D

Program of Requirements

jetBlue AIRWAYS

JFK International
Airport
Terminal 5
Redevelopment

Basis of Design
Appendix D :
Program of Requirements

ARUP
Design Manager

Gensler
Architect

DMJM HARRIS
Airside/Landside Engineer

D1. TERMINAL BUILDING PROVISION

		Minimum Number	Minimum Area (sq ft)		Criteria/Notes	
Departures						
Check-in						
Originating PHP	no	2,625		100%		
Check-in Counters	no	28			as per simulation	
Counter space	area		1,680	60	sq ft/ position	(5ft wide by 12 ft deep)
Lateral circulation at check-in counters	area		1,400	50	sq ft/ position	(5ft wide by 10 ft deep)
Queuing space at check-in counters	area		3,500	125	sq ft/ position	(5ft wide by 25 ft deep)
General circulation at check-in counters	area		3,220	115	sq ft/ position	(5ft wide by 23 ft deep)
Sub-total Check-in Counters Area	area		9,800		sq ft	
Curb Check-in Counters	no	12			as per simulation	
Sub-total Curb Check-in Area	area		900	75	sq ft/ position	(5 ft wide by 15 ft deep)
Kiosks (pax with bags)	no	24			as per simulation	
Kiosk space	area		864	36	sq ft/ position	(3 ft average wide by 12 ft deep)
Lateral circulation at kiosks	area		720	30	sq ft/ position	(3ft wide by 10 ft deep)
Queuing space at kiosks	area		1,800	75	sq ft/ position	(3ft wide by 25 ft deep)
General circulation at kiosks	area		1,656	69	sq ft/ position	(3ft wide by 23 ft deep)
Sub-total Kiosks (with bags) Area	area		5,040		sq ft	
Kiosks (pax without bags)	no	16			as per simulation	
Kiosk space (1 pax + 1 pax queued)	area		336	21	sq ft/ position	(3 ft wide by 7 ft deep)
Sub-total Kiosks (without bags) Area	area		336		sq ft	
Total Check-in Counters/Kiosks	no	80				
Sub-total	area		16,076		sq ft	
Security Screening						
Checkpoint Positions	no	20		19	position for pax simultd	1 position for crew
	area		10,304	515	sq ft/ position	TSA Recommended
Lateral Circulation	area		2,940	147	sq ft/ position	(14 ft wide by 10.5 ft deep)
No. Pax in Queue	no	325		325	as per simulation	
Queuing Area	area		3,575	11	sq ft/pax	IATA 2004 LOS C
Search Rooms	no.	3				
	area		225	75	sq ft/room	
Sub-total	area		17,044			
Total Departures Area	area		33,120			
Holdrooms						
A320/EMB190 Gates	no.	26				
Sub-total Holdrooms	area		50,861	1956	sq ft/ gate on average for 75%A320-25%EMB190 mix	
Total Holdroom Area	area		50,861		(See detailed Holdroom sheet)	
Domestic Arrivals						
Baggage Claim Devices						
Peak Hour Arrival Flights	no.	20			as per flight schedule	
150 ft Devices	no	6			as per simulation	
Device foorprint	area		12,150	2025	sq ft/ device	(45 ft by 45 ft per device)

Oversize belts/slides		no	1				
Device footprint at floor level		area		200	200	sq ft/ea. allowance	(5 ft by 40 ft)
Device presentation length and slide		area		180	180	sq ft/ea. allowance	(10 ft exposed by 18 ft deep)
Pax with bags		no.	377		65%	of peak pax at 6 carousels have bags, per simulation	
Pax using carts		no	151		40%	of peak pax at claim use carts (IATA)	
Cart storage		area		302	2	sq ft per stored cart	
	Sub-total	area		*12,832*			

Bag Claim Circulation and Arrivals Hall*

Arriving PHP		no.	1,970			as per simulation	
Peak pax at 6 carousels		no.	580			as per simulation	
Peak greeters at 6 carousels		no	236			as per simulation	
	Sub-total at carousels	no	816			as per simulation	
	Sub-total	area		*14,933*	18.3	sq ft/ person (IATA LOS C) Retrieval and Peripheral Area	
Peripheral circulation		area		*7,466*	50%	allowance	
Lateral circulation		area		*10,569*	30%	of above: allowance	
	Sub-total	area		*32,968*			
	Total Domestic Arrivals	area		*45,800*			

Airside Baggage Handling

Makeup

Flights in Make-up			52			Based on 2 1/2 hr arrival pattern; 15 minute last bag	
Staging length		ft	1,560		30	ft/ flight average (2 carts per flight)	
Make-up Devices (2 sides 78 ft expos.)		no	10		156	ft/ device (5 + 5 carts)	
		area		40,850	4085	sq ft/ device inclu. circ	(95 ft by 2x(5 ft + 10 ft + 6.5ft)
Oversize belts		no	1				
Device footprint at floor level		area		375	375	sq ft/belt	(5 ft wide by 75 ft long)
Device loading lane (1 side)		area		750	750	sq ft/belt	(10 ft wide by 75 ft long)
	Sub-total	area		*41,975*			

Domestic Off-load

Devices		no	6		3	carts per device	
Exposed Length		ft	55				(1 tug and 3 carts)
Device, Off-loading and Manoeuvring		area		14,070	2	lanes (of 3 belts each)	(35 ft wide by (55 + 12) ft long)/ belt
	Sub-total	area		*14,070*			

Hold Baggage Screening

EDS		area		26,000		Allowance	
	Sub-total	area		*26,000*			
	Total Baggage Handling	area		*82,045*			

JetBlue Operations / Business Partners

Operations

Aircraft Maintenance		area		*4,429*			
Corporate Security		area		*857*			
Crew Services		area		*1,352*			
Customer Service		area		*12,971*			
Facility Maintenance		area		*9,265*			
Flight Operations		area		*10,144*			
Inflight Services		area		*10,350*			

	Information Technology	area		3,077		
	People Department	area		3,089		
	Provisions/AC Catering	area		304		
	Ramp Services	area		10,790		
	JFK Operations	area		4,522		
	Technical Standards	area		188		
Business Partners						
	Cabin Cleaning	area		1,613		
	Checkpoint Security	area		2,711		
	Concessions (Administration)	area		3,088		
	Fueling	area		64		
	Janitorial Services	area		4,868		
	Skycap / Wheelchair Services	area		1,897		
Others						
	Loading Docks	area		2,948		
	Total JetBlue/Partners	area		88,467		
Other Areas						
	Stairwells at Gates	no.	26			
	Stairwell footprint (2 levels)	area		24,960	960 sq.ft allowance	(16 ft wide by 30 ft long at two levels)
	Fixed links at Gates	no.	13			
	Fixed links	area		9,100	700 sf each on average, allowance	(10 ft wide by 60-90 ft long, upper level)
	Covered road crossing pier	area		2,400		(25 ft wide by 96 ft)
	Total Other Areas	area		36,460		
Concessions						
	Total Concessions	area		46,000	Allowance, including storage	
NET AREA		area		382,753	Includes internal office area circulation	
	Mechanical/Electrical	area		53,585	14.0% of Net Area	
	Structural	area		22,965	6.0% of Net Area	
	Washrooms	area		21,051	5.5% of Net Area	
	Vertical Circulation	area		15,310	4.0% of Net Area	
	Lateral Circulation	area		95,688	25.0% of Net Area	
	Gross area to be allocated	area		34,000	Allowance	
GROSS AREA		area		625,353	Excluding connectors to Saarinen TS and AirTrain/ Parking Garage	

*** ARRIVALS HALL FIGURES INCLUDES PROVISION FOR HOTEL PHONE KIOSK AND GROUND TRANSPORTATION DESK. THE REQUIRED POWER AND DATA CONNECTIONS (INC FIDS) WILL BE MADE TO THESE LOCATIONS. CUSTOMER SEATING WILL BE PROVIDED IN THE ADJACENT AREAS**

D2. EXTERNAL PROVISION

A taxi queuing area, including covered customer waiting area, with standard booth, power and data (FIDs) connections and necessary signage will be provided on the curb frontage at the arrivals level

Appendix E

IT&T Infrastructure and Structured Cabling System

(Ex. 4)

Appendix F

Security Systems

jetBlue
AIRWAYS

JFK International Airport Terminal 5 Redevelopment

Basis of Design Appendix F : Security Systems

(Ex. 4)

ARUP
Design Manager

Gensler
Architect

DMJM HARRIS
Airside/Landside Engineer