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CONCEPTUAL SITE MODEL

Yakona Road Properties, Towson, Maryland

Prepared for Baker Botts on Behalf of Hess Corporation

1/25/2013

CONCEPTUAL SITE MODEL

Yakona Road Properties, Towson, Maryland

1/25/2013

Client

Baker Botts LLP
1299 Pennsylvania Ave., N.W.
Washington, DC 20004-2400

Consultant

Keith E. Green, CIH, CSP
WSP USA Corp.
11190 Sunrise Valley Drive
Suite 300
Reston, Virginia
20191
USA

Tel: 7037096500
Fax: 7037098500

Registered Address

WSP USA Corp.

WSP Contacts

Keith E. Green, CIH, CSP

Table of Contents

Figures

1 Introduction

Hess Corporation has requested that WSP Environment & Energy, now part of WSP USA Corp., (WSP) prepare a conceptual site model (CSM) for the Yakona Road properties located in Towson, Maryland. WSP understands that Hess would like an understanding of the environmental and geotechnical issues associated with transformation of eight duplex home lots into green space, specifically to be known as Baynesville Park. In this report, we present an understanding of the site conditions and a proposal for configuring the green space into an attractive, sustainable and environmentally protective manner.

2 Objectives

Plans for the properties that contain 1612 to 1642 Yakona Road, Towson, Maryland (Figure 1) include the creation of Baynesville Park. The purpose of the development of these properties is to eliminate any potential risk associated with residual amounts of hydrocarbons in groundwater (i.e., constituents of concern [COCs]).

A graphical interpretation of the conceptual site model is shown in Figure 2. The potential risks and risk pathways to be eliminated are potential human and environmental exposure to petroleum hydrocarbon constituents in:

- Soil vapor (C^{PHC}_{SV} on Figure 2 where PHC is "petroleum hydrocarbons") – previous soil gas and indoor air sample results identified COCs in the vadose (i.e., unsaturated) zone of soil and within air samples collected in certain duplex homes along Yakona Road. The COCs in the soil vapor is attributed to the compounds in shallow groundwater which can volatilize, partition from the groundwater, and enter the soil vapor phase above the water table. The COCs identified in the indoor air were attributed to volatilization from groundwater that entered the homes through basement sumps and seeps through the foundations and basement slabs.

  The creation of Baynesville Park will completely address any soil vapor concerns by not allowing groundwater to come to the surface. The development of the green space property (e.g., top soil, walkways, etc.) will eliminate any enclosed space, and therefore any potential for volatile COCs to accumulate in concentrations of potential concern.

- Groundwater (C^{PHC}_{o} and C^{PHC}_{x} on Figure 2) – Monitoring well and basement sump sampling showed that groundwater beneath the homes on Yakona Road contained low concentrations of COCs. Consuming or contacting contaminated groundwater poses a risk to human health. Groundwater is not intentionally consumed in this area of Towson as all homes and businesses are connected to the public water supply. Contact with or accidental ingestion of contaminated groundwater previously was possible in basement sumps during periods of basement flooding, and along the sidewalk and roadway when basement flood water was discharged.

  Creation of Baynesville Park with an appropriate groundwater control system will abate the groundwater contact pathway by properly discharging collected groundwater to either the local storm water sewer system or sanitary sewer system or both. In addition, any remaining affected groundwater will not be capable of discharging to the surface at the Yakona Road locations.

- Surface Water – Generally, surface water (e.g., storm water runoff) in the area does not contain COCs. However, basement sumps in the homes currently discharge to the surface on the sidewalk and onto the street in front of the homes. Therefore, groundwater from the sumps becomes surface water, which may be a potential human and environmental exposure pathway through volatilization to the air, direct contact, and accidental ingestion.

  Creation of Baynesville Park with an appropriate groundwater control system will abate the surface water pathway by not only eliminating all structures that result in the discharge of collected groundwater to sidewalks and streets, but also by conveying groundwater directly to either the local storm water sewer system or sanitary sewer or both, which prevents surface discharge. In addition, any remaining affected groundwater will not be capable of discharging to the surface at the Yakona Road locations.

- Soil – Although surface soil does not contain the COCs identified in groundwater, saturated soil (i.e., soil below the water table) is relatively shallow in the area of the Yakona Road homes. In this case, shallow soils may contain COCs which partition from affected groundwater.

  In the future green space, both engineering and institutional controls will be included. The engineering of the groundwater management and grading systems will create separation between near surface soils and the groundwater. Institutional controls can include restrictions placed on digging without appropriate protection procedures. Therefore, creation of a public green space will prevent contact with shallow saturated soil that may contain COCs.

3 Conceptual Site Model

Previous investigations have concluded that the COCs detected in the Yakona Road residential area were related, in whole or in part, to a subsurface petroleum release at the Hess gas station (No. 20204) located at 1613 East Joppa Road. Volatile organic compounds (VOCs) including benzene, toluene, ethylbenzene, and xylene (BTEX) as well as methyl-tert-butyl ether (MTBE) and other petroleum compounds (e.g., naphthalene) are in the soil vapor and groundwater media in this area. Analytical results for samples collected in May 2005 and January 2011 did not indicate the presence of COCs at concentrations higher than MDE Oil Control Program (OCP) cleanup standards in the surficial soils on the residential properties.

The generalized depiction of the specific migration pathways for COCs under the current (i.e., residential) land use conditions is provided in the conceptual site diagram in Figure 2. A more detailed summary of these migration pathways, along with the associated exposure routes and potential receptor populations, is presented in the CSM in Figure 3. An evaluation of the most recent sampling data indicates the presence of low concentrations of COCs in the shallow groundwater flowing southward (shown as $Q^{GW\ Flow}_{IN}$ in Figure 2) and the vapor phase in the overlying unsaturated soil zone. The subsurface hydrogeologic and hydrogeochemical conditions may allow for some degree of attenuation of the petroleum hydrocarbon compounds via adsorption (i.e., transfer to shallow soil) and biologically mediated degradation in the groundwater zone. Upon reaching the residences, some proportion of the groundwater flow would be collected by the French drain located immediately behind the houses (shown as $Q^{GW\ Flow}_{OUT}$ in Figure 2), with this water eventually being routed to the storm water sewer, while other groundwater enter the sub grade basements of homes via seepage through the floors and adjoining walls or flow into the basement sumps. The water collected in the majority of the sumps is conveyed through buried pipes to the street in front of the houses (shown as $Q^{GW\ Flow}_{OUT}$ in Figure 2). COCs present in any of the impacted water entering the basement areas may eventually volatilize and collect in the indoor air of the houses.

Future green space land use scenarios allow alternative engineering and institutional controls to be placed to control exposure pathways. Overall, the specific mechanisms for COC fate and transport in the soil vapor and groundwater would constitute a sub-set of the pathways recognized under the residential use option. Additionally, proper engineering controls would help minimize any chance that COC-impacted groundwater could discharge to un-paved ground surfaces during and immediately after major storm events, and potentially occurring as localized surface run-off.

The CSM in Figure 3 depicts potential exposure pathways for both the residential and green space land use options for the petroleum hydrocarbon-impacted environmental media discussed above. Based on the nature of petroleum contamination and associated migration pathways for each scenario, the exposure routes identified for the area of interest are linked to potential human receptors. The possibility for ecological receptor populations (i.e., flora and/or fauna) coming into contact with COCs was determined to be non-existent and thus constitutes no quantifiable risk. The magnitude of potential exposures by the various human receptors is largely dependent on the nature and duration of activity being conducted on the impacted property area.

Given the current land use and identified exposure routes, the potential human receptors include the following (Figure 3):

- Residents and visitors/guests
- Trespassers
- Maintenance, utility, and construction workers

The risk assessment completed as part of WSP's 2011 site investigation activities designated the house occupants as the primary site receptors under the residential land use scenario. The potential risks to the other receptors were considered less than the potential range of risk for the resident receptors. The "reasonably foreseeable" standard was used to determine the future exposure pathways associated with use of the property as green space. Using this approach, potential human receptors identified that take into consideration the exposure routes for petroleum-related constituents at the site are maintenance, utility, and construction workers (Figure 3).

Public visitors to the area and workers (e.g., landscape and lawn maintenance personnel) could potentially be exposed to COCs diffusing into the ambient air or present in areas of impacted shallow groundwater. In addition, utility workers could become exposed to petroleum-impacted groundwater discharged to the storm water sewer located a short distance south of the 1616/1618 Yakona Road duplex. For the COC-containing soil vapor and groundwater, complete exposure routes would consist of inhalation of vapors. Absent a properly designed drainage network, possible seepage during storm events could allow dermal contact and incidental ingestion. The transformation of the properties to Baynesville Park can be implemented in a way to interrupt and minimize each of these potential exposure routes.

4 Key Considerations for Successful Transformation

During the development of Baynesville Park, the key considerations that factored into our analysis of the design of the park including engineering and institutional controls are:

1. Eliminate Potential Risk to Human Health and the Environment
    a. Stable Plume – The proposed system will be designed to reduce the flux within the plume at the edge of the pavement groundwater surface to concentrations that will naturally attenuate.
    b. Minimization of Potential Long-term Exacerbation of Downgradient Conditions (no increase in net discharge)
        i. Soil Vapor – Control the plume surface so there is no net increase in soil vapor migration from the groundwater surface.
        ii. Groundwater – Control the groundwater flow to reduce the potential that groundwater will discharge at or above the sidewalk or Yakona Road.
        iii. Surface water – Control surface water flow to reduce the potential that surface water will discharge from the site at or above the sidewalk or to the street at a rate that poses a hazard to pedestrians or traffic.
2. Sustainable Site Plan
    a. Stable Slopes – The back and side walls of the homes are currently providing support for the hillside above the structures. The alternatives must maintain the conditions to eliminate the potential for slope movements.
    b. Preventing groundwater emerging as a seep – As stated earlier, this is primarily a potential exposure concern; however, the emergence of groundwater in the form of a seep poses long-term issues associated with maintaining vegetation, limiting concerns associated with iron staining and iron-reducing bacteria, and potential winter hazards in the form of icing on walkways and roadways.
    c. Grade suitable for proposed uses – The homes currently dictate the grades along and near the sidewalk. The proposed green space can either maximize the relatively level area by raising the grade or maximize accessibility by cutting the site grades to the sidewalk level.
    d. Plantings suitable for location and proposed level of care – The green space can provide ecological habitat, an area for recreation, or simply a means to plant vegetation that promotes attenuation of the groundwater and associated COCs (i.e., phytoremediation). Recreational uses require the most care, while phytoremediation requires the most intense planting schedule.

5 Alternatives Analysis

Based on the potential for different configurations of the site and the varying options for the control of groundwater, WSP considered seven alternatives for the creation of Baynesville Park at the Yakona Road site.

The components of the alternatives included:

1. Demolition
   a. Above Grade – The removal of asbestos-containing materials, chemicals, and utilities is common to all alternatives.
   b. Site Grading – There are two alternatives associated with the grading. If the site is raised with a retaining wall at the sidewalk location, the below grade walls and slabs may remain in place.[1] If the sidewalk grade is selected, the foundation walls will likely have to be removed.
2. Groundwater Flow Management – As shown in the CSM, the groundwater flow at the site is generally discharged in three ways; the community French Drain, the sump discharges, and as groundwater flowing in the direction of Yakona Road. To avoid the potential exposure associated with surface discharge of groundwater and to prevent risks associated with wet and icy conditions, the groundwater managed under the rebuilt conditions must be at or in excess of current flows. WSP considered four alternatives for the management of groundwater flow:
   a. Rehabilitation of Existing Drain – The existing drain could be rehabilitated for use in the redesigned system. Cleanouts would likely be installed at two or more locations on the drain, the piping would have to be routed to remove roots and other accumulations, and the system would have to be treated to remove iron deposits. Due to the unknown position, unknown conditions, and indeterminate life of the existing piping, WSP is not recommending dependence on the existing system. For the alternatives where the site grade is raised, the existing drain can likely be left in place.
   b. Replacement of Existing Drain – Replacing the existing drain with a new French Drain traversing properties from 1616 to 1642 Yakona Road would allow collection and discharge of the flow to the storm sewer; however, the grade of the drain must be further reviewed to ensure that the extension of the drain is feasible. Additionally, this assumes that the groundwater (including groundwater from below the former source) can be discharged[2] to the storm drain.
   c. New Drain Discharging to Sanitary Sewer – The groundwater from the areas north of 1638 Yakona Road[3] can be more effectively controlled by discharging to the sanitary sewer rather than lengthening the French drain, which will require a grade that may not be possible based on site conditions. Directing this water directly to the sanitary sewer allows a steeper gradient, and therefore more effective and higher volume control. This would however require two drains to be installed (Figure 4). The two drain system would allow collection and discharge of the groundwater to the east of the existing French drain. This water will be discharged to the sanitary sewer for treatment at the publically owned treatment works (POTW)[4]. The existing French drain, or a suitable replacement would continue to collect groundwater downgradient of this to be discharged to the storm sewer.
   d. Phytoremediation – Phytoremediation, for purposes of groundwater management, can be accomplished with trees that hyperaccumulate water, such as poplar and willow species. These trees can uptake and transpire large amounts of water in the growing season. However, there are negative attributes associated

[1] The development requirements of Baltimore County would have to be checked.

[2] The MDE requirements for quality of storm water to be discharged to storm sewers must be verified.

[3] According to historical site plans, it is likely that the existing French Drain does not extend this far north.

[4] Compliance with municipal pre-treatment standards is assumed. The POTW would have to be contacted to determine requirements for discharge to the sewer and for sampling requirements.

with these trees used as part of a groundwater management system. For example, these species tend to have low water uptake in the winter, they have low and wide root systems that can clog piping systems (e.g., French drains), and healthy trees require maintenance. Therefore, the use of trees for groundwater management is not recommended.

3. COC Reduction and/or Management – The groundwater system contains residual COCs. The proposed alternatives are all based on the understanding that the source of the COCs was remediated, and that the concern at the residential properties is associated with residual concentrations that migrate into this area. The alternatives associated with the management of the COCs in groundwater include:

    a. Replacement of Existing Drain – Replacing the existing drain with a new French Drain that traverses all of the properties would allow for collection and discharge of additional groundwater. The positioning of this drain could potentially increase the gradient, and therefore, accelerate the removal of the COC mass as well as reduce migration of COCs downgradient of the site.

    b. New Drain discharging to Sanitary Sewer – Like the replacement drain, a two drain system would allow for increased collection and discharge of groundwater. Additionally, groundwater closest to the former source would be more effectively controlled and collected faster with the higher gradient allowed by discharge to the sanitary sewer. This would require permission to tap the closest manhole and discharge from the POTW.

    c. Phytoremediation – There are trees that hyperccumulate petroleum hydrocarbons. These trees can be planted in areas of the properties to collect and accumulate hydrocarbons.

    d. Enhanced Natural Attenuation – Petroleum hydrocarbons naturally attenuate in groundwater systems. The rate of attenuation is a function of the conditions in the groundwater system. Given a set of relatively straightforward tests, WSP can determine what, if any, conditions are deficient for effective attenuation of the plume.

    e. Natural Attenuation – Hydrocarbons are organic materials that will degrade naturally in the environment. If conditions to enhance the attenuation are not available or needed, natural attenuation will occur.

4. Soils and Surface Development – The management of soils and the surface development is simply a function of the proposed future use of the site and the balance of the risk associated with proximity to groundwater when considered against the risks associated with an elevated wall near the sidewalk.

    Two alternatives for the grading were considered: raising the grade along the sidewalk to provide additional separation of the surface and groundwater, reducing the potential for creating a new groundwater seep or cutting the grade to a relatively lower elevation that closely matches the current grade of the side walk. The key attributes of these alternatives are:

    a. Retaining Walls – Although no topographic mapping is available for the site, the observations made to date indicate that a retaining wall will likely be required to maintain sustainable site slopes and prevent long-term soil erosion. If the site grades are raised, the retaining wall will be near the sidewalk. If the site grades are cut, the retaining wall would be positioned closer to the existing tree line. Although the filling of the site will create a greater area of “level” space and increase the distance between the groundwater and ground surface, a railing or other protective barrier would be required at the top of the wall. The potential for the tall edge at the sidewalk and the long-term care required for protective guardrails pose a concern.

    b. Surface Water Management – Runoff from the area must be controlled to mitigate any concerns associated with water running (and potentially freezing) on the sidewalk and roadway.

    c. Trees and Planting – The future use of the area will dictate the trees and planting schedule.

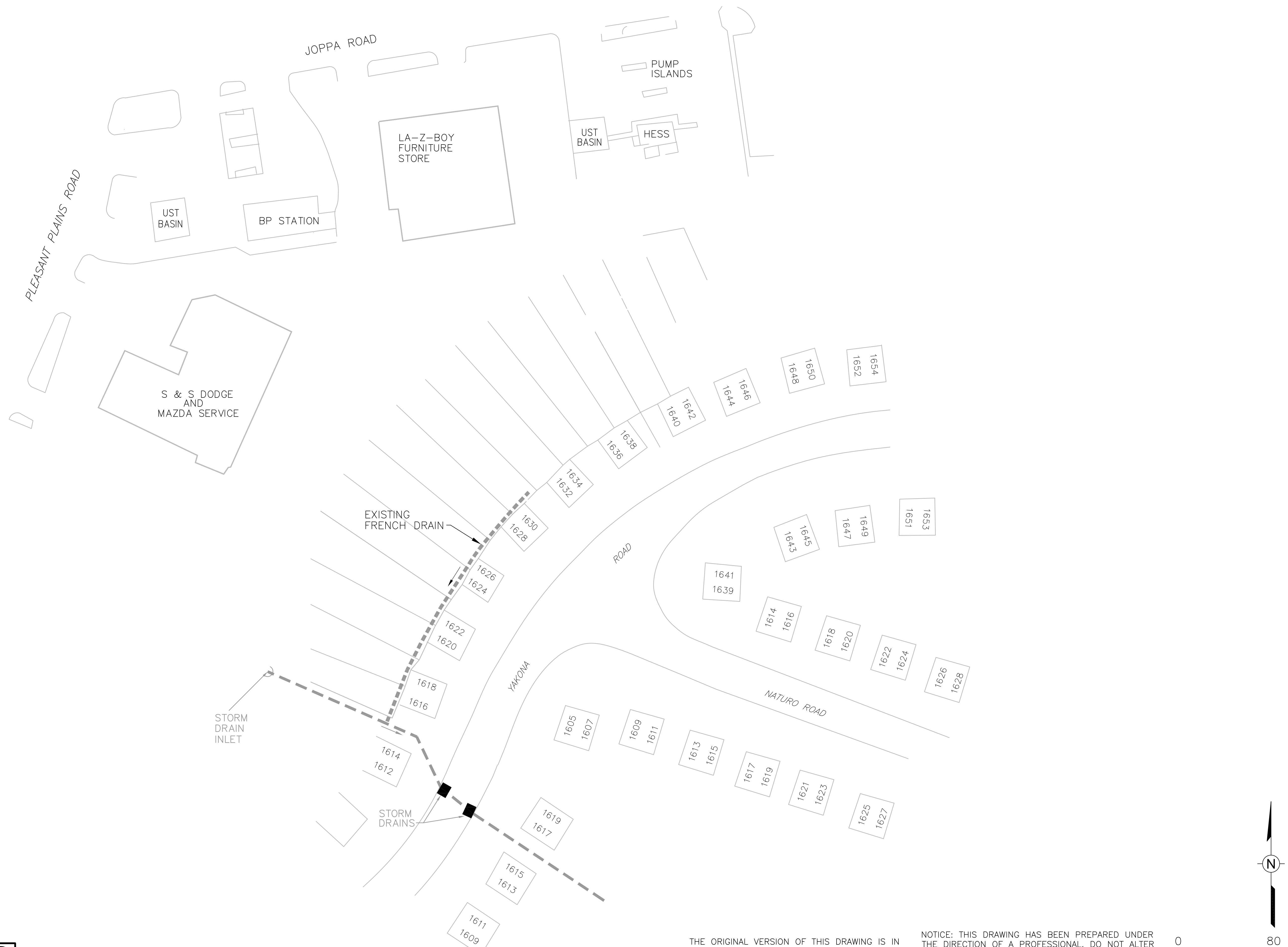
6 Summary and Recommendation

WSP prepared this report to describe the detailed evaluation conducted for potential alternatives for the transformation of the Yakona Road properties into a sustainable green space. The main objective of the transformation is the elimination of all potential exposure pathways to the COCs identified in the groundwater at the site. Various alternatives representing variations of three key variables: site grading, groundwater management, and COC migration control were evaluated. Each of the alternatives met the objective for the transformation of the residential properties into a sustainable green space while removing or reducing the potential exposure pathways.

The recommended alternative (Figure 4) includes: the grading to match the sidewalk grade; two separate drains, one for the groundwater to the east of the existing French drain (Figure 5), routed to a sanitary sewer, and the second, collecting groundwater that will discharge to the storm system; and a nearly 2-acre Park (Baynesville Park, Figure 6). The use of the two drain system provides additional advantages as it separates the drainage to allow a steeper gradient, and therefore, more effective control of the groundwater, and prevents concern about potential exposures at the storm water outlet.

This alternative not only provides an effective solution to the residual hydrocarbons in groundwater, it provides a sustainable green space for the community. Hess is proposing to add amenities such as a walkway, benches and multiple tree and shrub species (with educational signage for the trees and shrubs) to enhance the community park.

Figures



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REFERENCE: EMS ENVIRONMENTAL FIGURE 1, TITLED SITE PLAN, DATED 9/16/10.

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Approved: 11/16/2012
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YAKONA ROAD PROPERTIES
TOWSON, MARYLAND
PREPARED FOR
BAKER BOTTS, LLC

Figure 1

SITE LAYOUT

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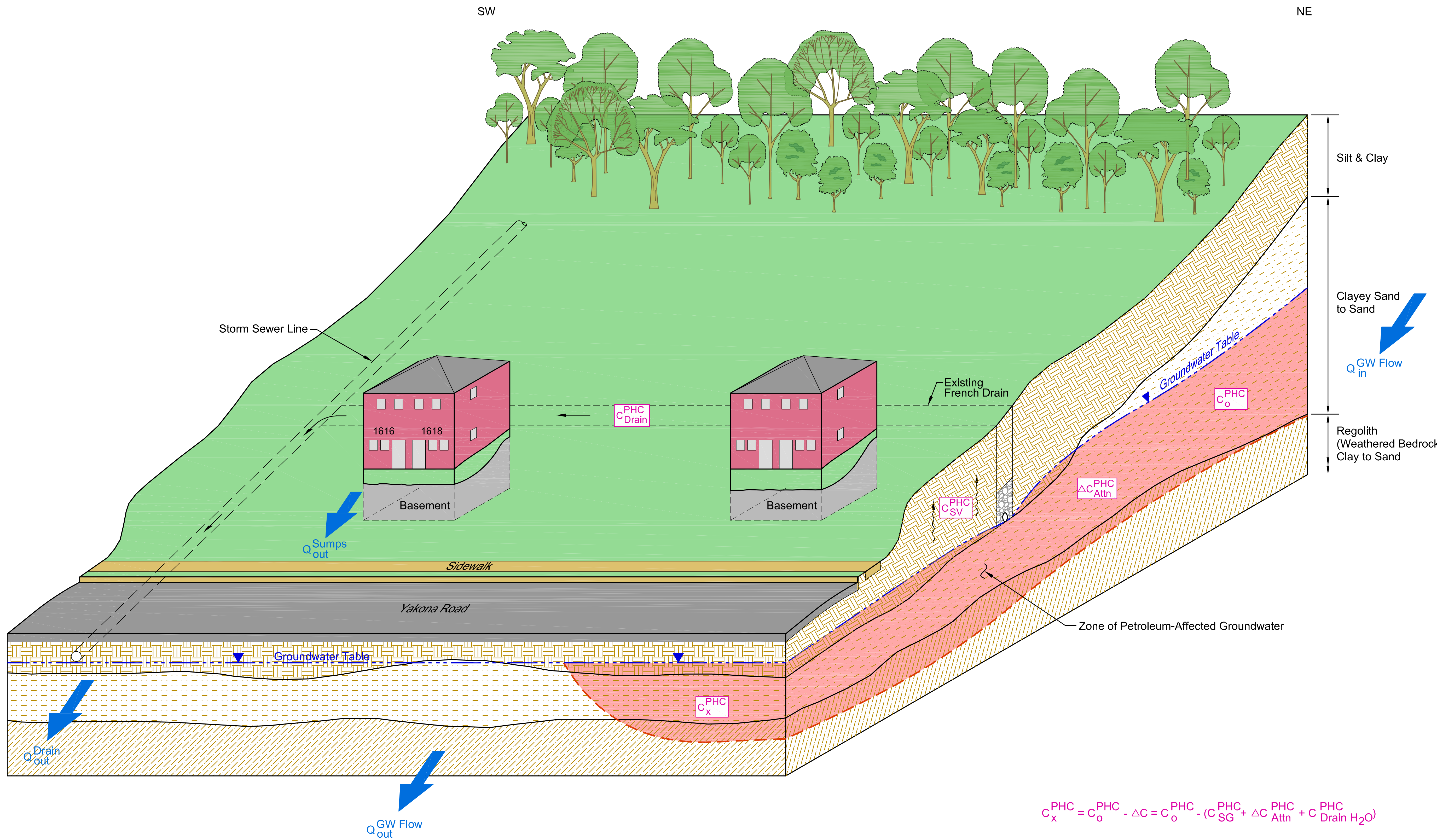

$$C_x^{PHC} = C_o^{PHC} - \Delta C = C_o^{PHC} - (C_{SG}^{PHC} + \Delta C_{Attn}^{PHC} + C_{Drain\ H_2O}^{PHC})$$

C_x^{PHC}	Petroleum Hydrocarbon Constituents (PHC) Concentration in Groundwater Downgradient of Residences
C_o^{PHC}	PHC Concentration in Groundwater Upgradient of Residences
ΔC_{Attn}^{PHC}	PHC Concentration Change From Attenuation Process
C_{SV}^{PHC}	PHC Concentration in Soil Vapor
C_{Drain}^{PHC}	PHC Concentration in French Drain Water

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YAKONA ROAD PROPERTIES
TOWSON, MARYLAND
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Figure 2

CONCEPTUAL DIAGRAM OF CURRENT SITE CONDITIONS

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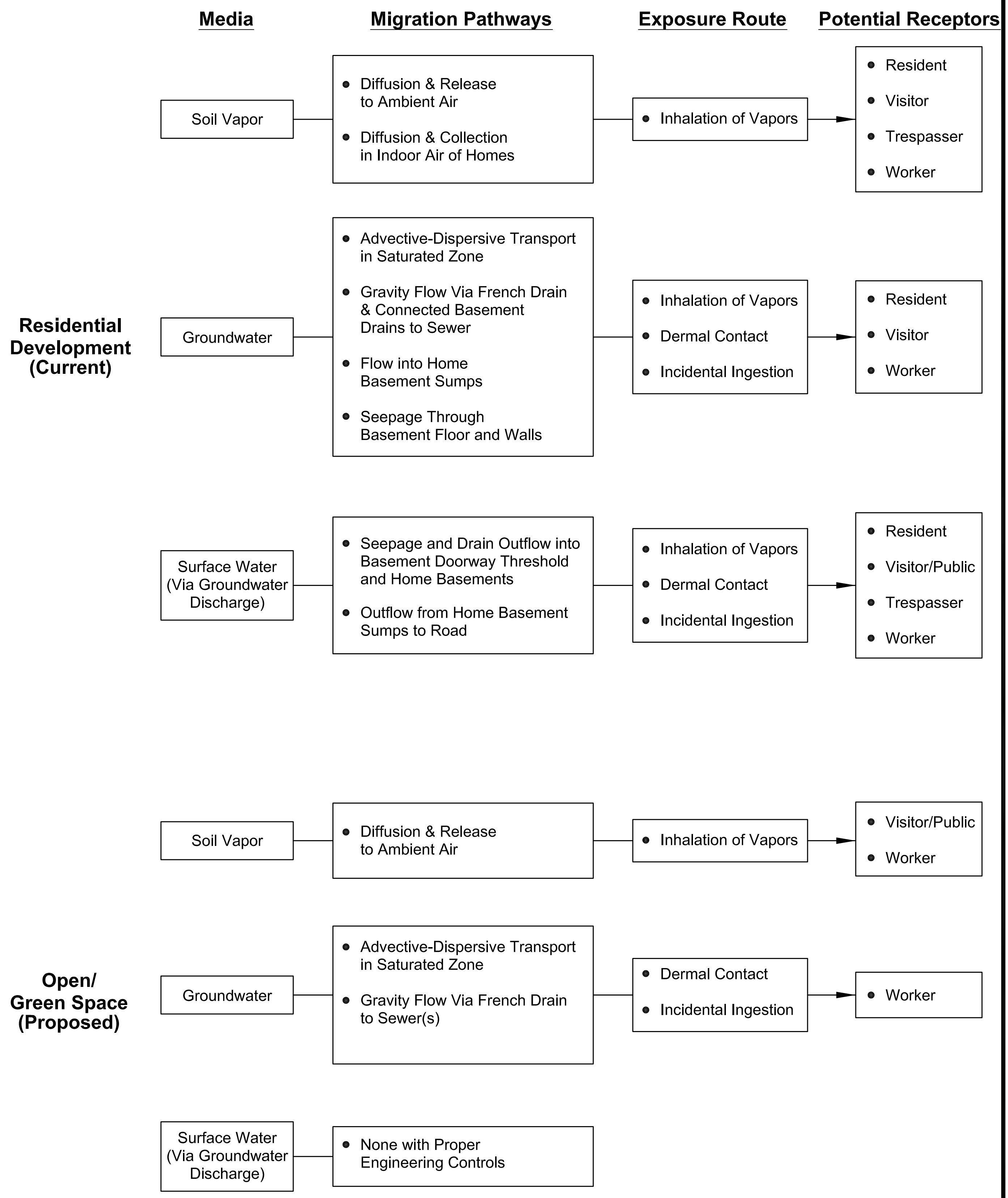

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Figure 3

CONCEPTUAL SITE MODELS FOR CURRENT RESIDENTIAL AND PROPOSED GREEN SPACE USE

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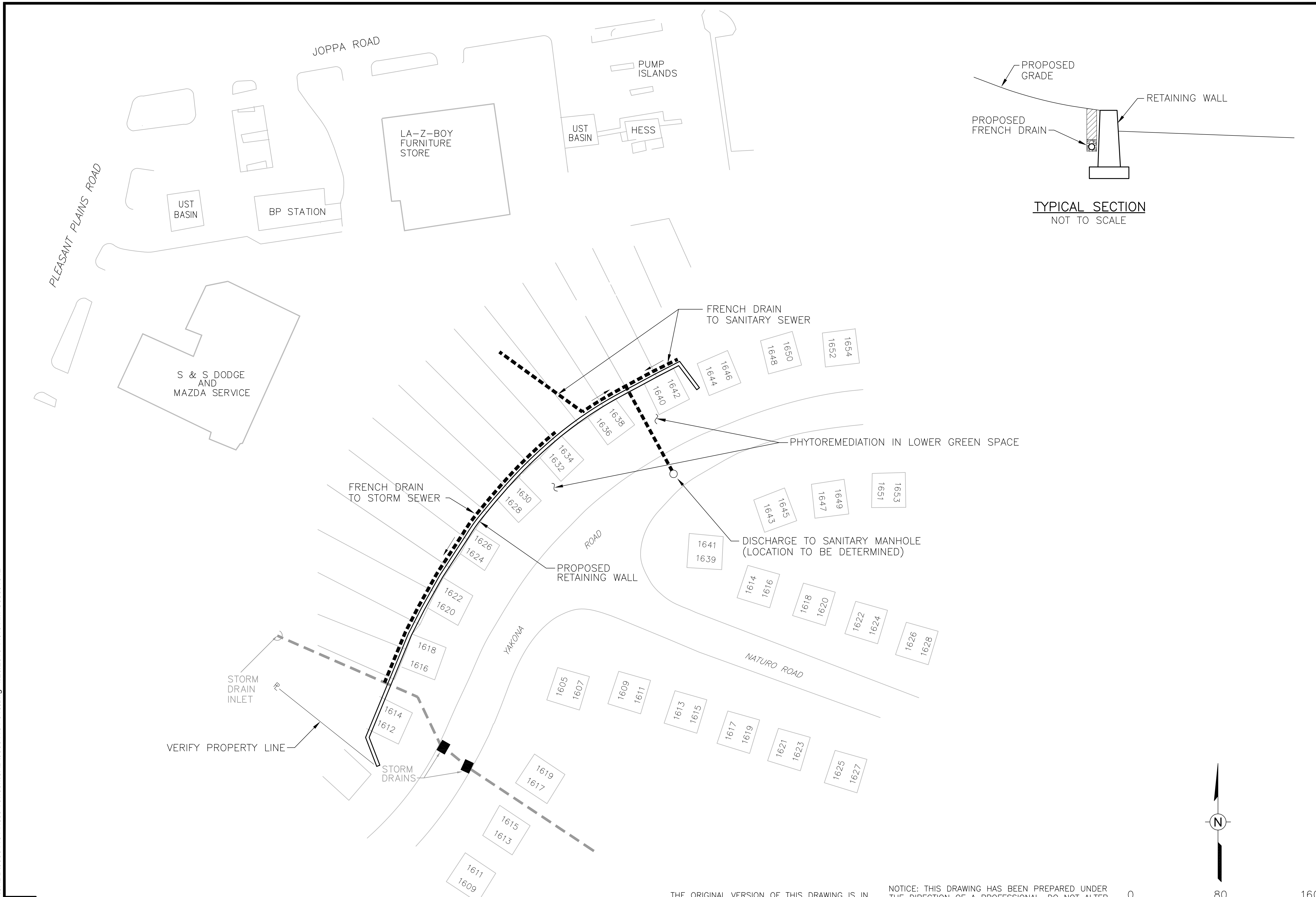

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Figure 4

WATER MANAGEMENT
RECOMMENDED ALTERNATIVE

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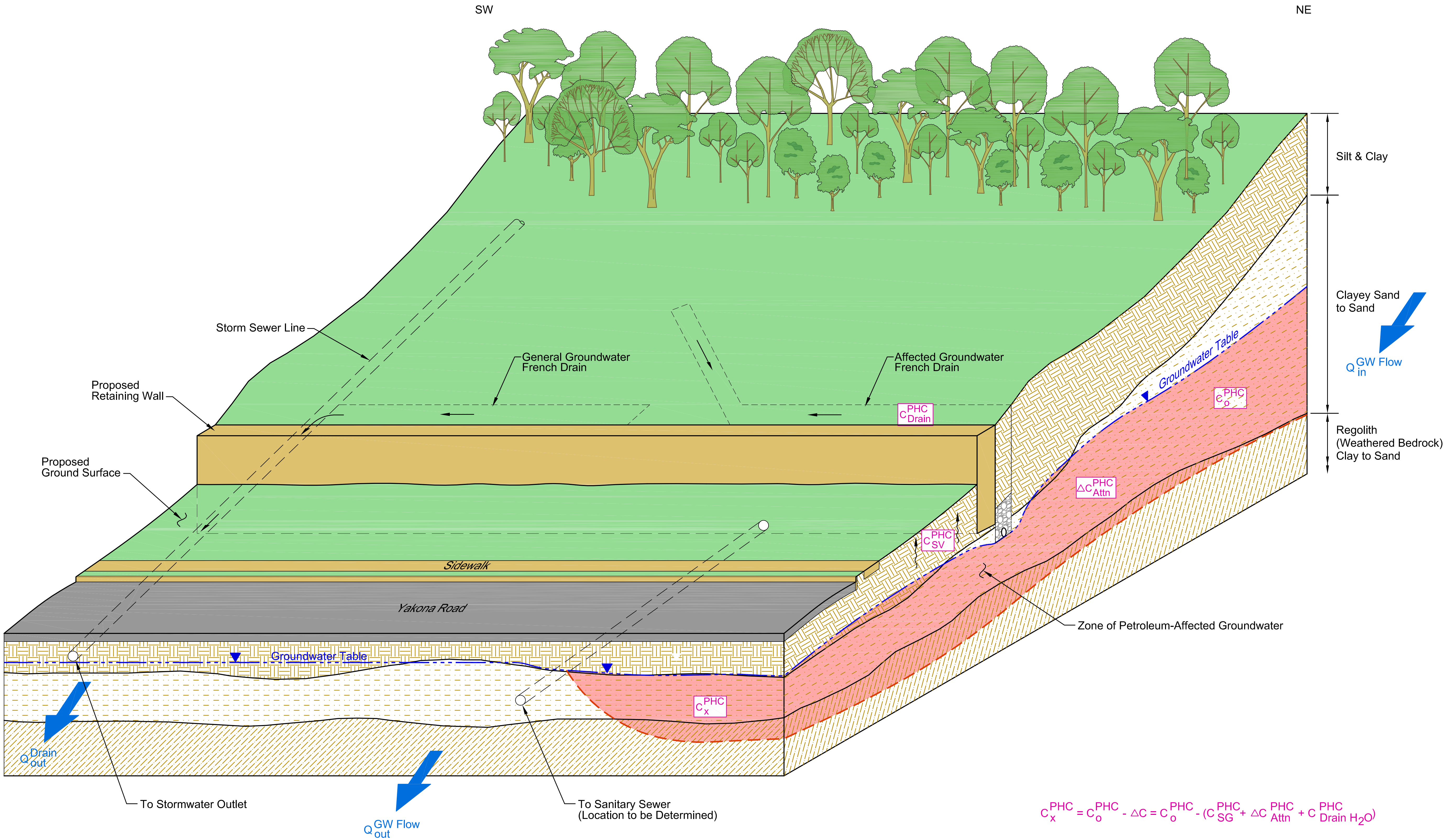

$$C_x^{PHC} = C_o^{PHC} - \Delta C = C_o^{PHC} - (C_{SG}^{PHC} + \Delta C_{Attn}^{PHC} + C_{Drain\ H_2O}^{PHC})$$

C_x^{PHC} Petroleum Hydrocarbon Constituents (PHC) Concentration in Groundwater Downgradient of Residences

C_o^{PHC} PHC Concentration in Groundwater Upgradient of Residences

ΔC_{Attn}^{PHC} PHC Concentration Change From Attenuation Process

C_{SV}^{PHC} PHC Concentration in Soil Vapor

C_{Drain}^{PHC} PHC Concentration in French Drain Water

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YAKONA ROAD PROPERTIES
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Figure 5

CONCEPTUAL DIAGRAM OF
RECOMMENDED ALTERNATIVE

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LEGEND

EXISTING TREES

1, 2, 3, & 4 — PROPOSED TREES

5, 6, & 7 — PROPOSED SHRUB

PROPOSED TREE LEGEND

1 OAK, WHITE (QUERCUS ALBA) – MARYLAND STATE TREE
HEIGHT: 80'–100', SPREAD; 50'–80'. CLASSIC OAK FORM WITH STRONG BRANCHES. PYRAMIDAL IN YOUTH, BECOMING BROAD AND ROUNDED WITH WIDE SPREADING BRANCHES. TRANSPLANT AS SMALL TREE. PREFERS MOIST, WELL DRAINED SOILS. DIFFICULT TO OBTAIN FROM NURSERIES. SOMETIMES AVAILABLE AS SEEDLING. WORTHWHILE TREE FOR LARGE AREAS. ACORNS ARE AT THE TOP OF THE FOOD PREFERENCE LIST FOR WOOD DUCKS, PHEASANTS, GRACKLES, JAYS, NUTHATCHES, THRUSHES, WOODPECKERS, RABBITS, FOXES, SQUIRRELS AND DEER. (4 PROPOSED)

2 TUPELO OR GUM, BLACK (NYSSA SYLVATICA)
HEIGHT: 30'–70', SPREAD: 30'–45'. PYRAMIDAL IN YOUTH AND IRREGULARLY CROWNED AT MATURITY. PREFERS MOIST, WELL DRAINED, ACID SOILS. FULL SUN OR SEMI–SHADE. DEEP TAPROOT. SPECTACULAR FALL COLORS MAKE IT A FINE CHOICE AS A STREET TREE IN RESIDENTIAL AREAS. TOLERATES SEACOAST CONDITIONS. FRUIT IS RELISHED BY MANY SONGBIRDS. USERS INCLUDE WOOD DUCKS, ROBINS, WOODPECKERS, THRASHERS, FLICKERS, AND MOCKINGBIRDS. (4 PROPOSED)

3 HOLLY, AMERICAN (ILEX OPACA)
HEIGHT: 15'–30', SPREAD: 18'–25'. DENSE, PYRAMIDAL IN YOUTH, OPENING UP WITH AGE. PLANT IN MOIST, WELL DRAINED SOIL. FULL SUN OR PARTIAL SHADE. USE ONE MALE FOR EVERY THREE FEMALES. USE AS SPECIMEN PLANT OR IN GROUPINGS. MANY CULTIVARS. USED EXTENSIVELY BY MANY SONGBIRDS INCLUDING THRUSHES, MOCKINGBIRDS, CATBIRDS, BLUEBIRDS AND THRASHERS. FOLIAGE PROVIDES COVER FOR SONGBIRDS AND MAMMALS. (4 PROPOSED)

4 DOGWOOD, AMERICAN FLOWERING (CORNUS FLORIDA)
HEIGHT: 20', SPREAD: 15'–20'. SMALL TREE WITH FLAT TOPPED CROWN. PLACE IN WELL DRAINED SOIL. FULL SUN TO PARTIAL SHADE. HAS CHARACTER IN ALL FOUR SEASONS. EXCELLENT AS SPECIMEN TREE OR USED ON THE CORNER OF A HOUSE. BRIGHT RED BERRIES ARE AN IMPORTANT FOOD SOURCE FOR SONGBIRDS INCLUDING EVENING GROSBEAK, CARDINALS, ROBINS AND CEDAR WAXWINGS. (5 PROPOSED)

5 PINK AZALEA, PINXTERBLOOM (RHODODENDRON PERICLYMENOIDES)
MEDIUM SHRUB WITH PINK AND WHITE FLOWERS BETWEEN APRIL AND MAY. (5 PROPOSED)

6 SILKY DOGWOOD (CORNUS AMOMUM)
MEDIUM SHRUB WITH WHITE FLOWERS BETWEEN MAY AND JUNE. (11 PROPOSED)

7 SWAMP AZALEA (RHODODENDRON VISCOSUM)
MEDIUM SHRUB WITH PINK AND WHITE FLOWERS BETWEEN MAY AND AUGUST. (6 PROPOSED)

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SCALE IN FEET

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REFERENCE: EMS ENVIRONMENTAL FIGURE 1, TITLED SITE PLAN, DATED 9/16/10.

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APPROVED 12/19/2012

BAYNESVILLE PARK CONCEPT
TOWSON, MARYLAND

YAKONA ROAD PROPERTIES
TOWSON, MARYLAND
PREPARED FOR
HESS CORPORATION

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11190 Sunrise Valley Drive, Suite 300
Reston, Virginia 20191
(703) 709-6500
www.wspenvironmental.com/usa

FIGURE 6

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11190 Sunrise Valley Drive
Suite 300
Reston, Virginia
20191
USA
Tel: 7037096500
Fax: 7037098500

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