Building Interstate Natural Gas Transmission Pipelines: A Primer

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The INGAA Foundation, Inc.

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Cover photo courtesy of Alliance Pipeline.

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[1] See foreword for a description of the process used to determine space requirements.

Foreword

This primer was written to explain how interstate natural gas pipelines are constructed, from the planning stages to completion. The primer is designed to help the reader understand what is done during each step of construction, how it is done, the types of equipment used, and the types of special practices employed in commonly found construction situations.

It also describes practices and methods used to protect workers, ensure safe operation of equipment, respect landowner property, protect the environment and ensure safe installation of the pipeline and appurtenances.

This report is meant to be used by all those interested in pipelines and their construction, including federal agencies, landowners, the public, state and local governments, emergency responders and new employees of pipeline and construction companies.

This primer, which was reviewed by INGAA Foundation member companies, updates previous works produced by the INGAA Foundation.

In particular, the steering committee working group determined nominal technical space requirements discussed in Appendix A. This group also designed the drawings in Appendix B. Project specific circumstances will have a bearing on the workspace proposed by individual pipeline project applicants. When determining nominal workspace requirements, the pipeline company must consider the space needed for the safest construction possible, including personnel safety, staging of pipe and pipeline appurtenances, efficient movement of materials and equipment, as well as diligent management of environmental impacts.

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Introduction

The Interstate Natural Gas Association of America (INGAA) represents the industry that constructs, operates and maintains interstate natural gas pipelines. The INGAA Foundation comprises service providers that engineer, design, permit and construct interstate natural gas pipelines, as well as INGAA members.

Interstate natural gas pipelines are the pipelines that transport natural gas across state lines. These pipelines typically carry significantly larger volumes than gathering lines (pipelines within a field that bring natural gas from production wells to a processing plant), intrastate pipelines (those that transport natural gas within a state), or distribution pipelines (those that provide gas to homes and businesses).

Because this document focuses on interstate natural gas pipelines, the regulatory environment discussed largely is federal because federal agencies, including the Federal Energy Regulatory Commission (FERC) and the Pipeline and Hazardous Materials Safety Administration (PHMSA), among others, are the primary regulators of these pipelines.

A working group comprised representatives of Foundation member companies with expertise in engineering, design, permitting, construction, inspection, operations and maintenance developed this primer between 2009 and 2012. The group met every other month for approximately two years to develop the body of the primer. Guidance on temporary workspace requirements for construction was developed by the working group during that time, but work on that topic extended into 2011 and 2012.

A review of projects constructed in the "boom" period of 2006 to 2010 was conducted in late 2011 and into 2012 to review the appropriateness of the guidance provided on temporary workspace requirements. The primer has undergone extensive review on two occasions by Foundation members and was shared for external review from interested stakeholders.

The safety of the crews that construct interstate natural gas pipelines and the safety of those who live and work near these lines is the industry's primary concern during the pipeline construction process. Other priorities include protecting landowners' property, preserving the environment in the construction zone and constructing a pipeline that meets project specifications, on time and on budget. Landowners and other stakeholders that may be affected by pipeline construction need accurate information so they can understand clearly the steps involved in constructing a pipeline—from the pre-construction and planning stages, to obtaining the required approvals and Certificate of Public Convenience and Necessity, to building and placing the pipeline into service.

This document outlines the processes, precautions and construction methods and requirements practiced in pipeline construction. It also describes the up-front efforts and approvals required of the operator by numerous regulatory agencies and government bodies before the first shovelful of dirt is ever moved.

This document also describes the regulatory environment and requirements established by FERC (Federal Code of Regulations Title 18), Bureau of Land Management (BLM) (Federal Code of Regulations Title 43), PHMSA (Federal Code of Regulations Title 49), U.S. Army Corps of Engineers (USACE) (Federal Code of Regulations Title 33), Environmental Protection Agency (EPA) (Federal Code of Regulations Title 40), Fish and Wildlife (Federal Code of Regulations Title 50) and others that regulate the design, construction, operation and maintenance of interstate natural gas pipelines. These regulations can be found at http://www.gpo.gov/fdsys/. Additional resources including videos showing construction sequences can be found at www.ingaa.org.

When developing pipeline expansion projects, pipeline companies and their experts conduct a comprehensive consultation process with all stakeholders to develop a technically feasible and safe pipeline route that achieves a balance between the number of landowners affected, impact to the environment and construction requirements.

Engineering firms, constructors and operators adhere to strict safety regulations set by the U.S. Department of Transportation and the Occupational Safety and Health Administration (OSHA). FERC is an independent agency that regulates the interstate transmission of electricity, natural gas and oil. Under the Natural Gas Act (NGA) and the National Environmental Policy Act (NEPA), FERC is the lead permitting agency for U.S. interstate natural gas pipeline projects. See www.ferc.gov for additional information.

The INGAA Foundation Primer on Building Interstate Natural Gas Pipelines includes six major sections that outline the steps taken to develop and construct a new pipeline. They are:

1. Needs Analysis and Project Justification
2. Project Authorization and Certification
3. Overview of Construction
4. Special Construction Techniques
5. Post-Construction Maintenance
6. Summary

Many variables impact the construction of a new pipeline. The primer addresses many of these variables, but it is impossible to address them all. The variables addressed include:

- Scheduling to complete a project in a timely manner.
- Workspace needs necessary for safe construction, operation and maintenance.
- Environmental considerations such as sensitive habitats and wetlands, archaeological sites, and topological features such as steep hills and side slopes that create specific workspace and safety needs.
- Regional differences, such as population density, which often impact working considerations.
- Route selection analysis that focuses on minimizing potential impacts to agricultural lands, homes, communities, areas of planned future development, and environmentally sensitive areas such as wetlands, state parks and forested areas.

Appendices are included to address the following:

Appendix A - Technical Basis for Nominal Right-Of-Way Widths, Separation, Workspace and Additional Temporary Workspace

Appendix B – Standard Construction Drawings

Appendix C – Guidelines for Parallel Construction of Pipelines

Why We Need Natural Gas Pipelines

The primary objective of interstate natural gas pipelines is to provide safe and reliable transmission of natural gas. The U.S. natural gas pipeline network is a highly integrated transmission and distribution grid that connects natural gas sources to power plants, manufacturers, businesses and homes. Pipelines transport natural gas to and from nearly every location in the lower 48 States.

Natural gas is abundant in North America and current estimates point to more than a 100-year supply. Transporting that gas from production source to market will require expansion of the existing pipeline infrastructure, especially as new supply sources develop. Natural gas is used to heat homes, generate electricity, power manufacturing plants and fuel transportation. It also is used as a raw material in a wide range of products, including plastics and fertilizer. Its versatility does not stop there. Natural gas is an excellent low-emission fuel to complement renewable wind and solar, which currently have significant technical limitations on energy deliverability, and can be used as a transportation fuel.

Expanding efficient pipeline transportation is critical to America's energy future and the overall economy. Pipelines remain the energy lifelines that power nearly all Americans' daily activities at home and at work.

1.0 Needs Analysis and Project Justification

Before interstate natural gas pipeline construction may begin, a pipeline company must receive a Certificate of Public Convenience and Necessity ("certificate") from the FERC. FERC plays a key role in the development of new U.S. pipeline projects. It has jurisdictional responsibility for the siting of new natural gas pipelines and is the lead federal agency in the review of a project under NEPA. FERC regulates the interstate transmission of natural gas, and it is charged with authorizing proposed interstate transmission projects. FERC determines whether proposed projects are needed and are in the public interest and it applies "just and reasonable" rates for pipeline transportation. FERC monitors compliance through construction and operational commissioning.

Delays in meeting the deadline for pipeline construction can mean delays in supplying gas to customers and businesses, and other adverse consequences. On average, using the pre-filing process it takes about 18 to 20 months to get a project through planning and FERC approval and ready to proceed with construction. It can take much longer for larger or more complex projects or projects that are changed after filing. See figure 1 for the regulatory project timeline and components of successful pipeline projects. The project's schedule is developed based on:

a) An established deadline for natural gas deliveries to the end user(s);
b) Various agencies' permitting requirements;
c) Affected stakeholders consultation and outreach; and
d) Construction activities.

Other factors that may affect the project timeline include delays in end-use plant siting, difficulty in obtaining project financing, landowner opposition and regulatory delays. Choosing project sites in a timely and cost-efficient manner will provide the end user receiving the natural gas supplies in-service certainty and avoid unnecessary costs to the consumer. Regulatory certainty is an important element in attracting private sector investment into energy infrastructure. Investors must see that decisions by regulators are based on the law and the facts. It is important that there be some level of predictability and constancy in regulatory decisions. Overall, the FERC pipeline regulation process is characterized by a high level of regulatory certainty.

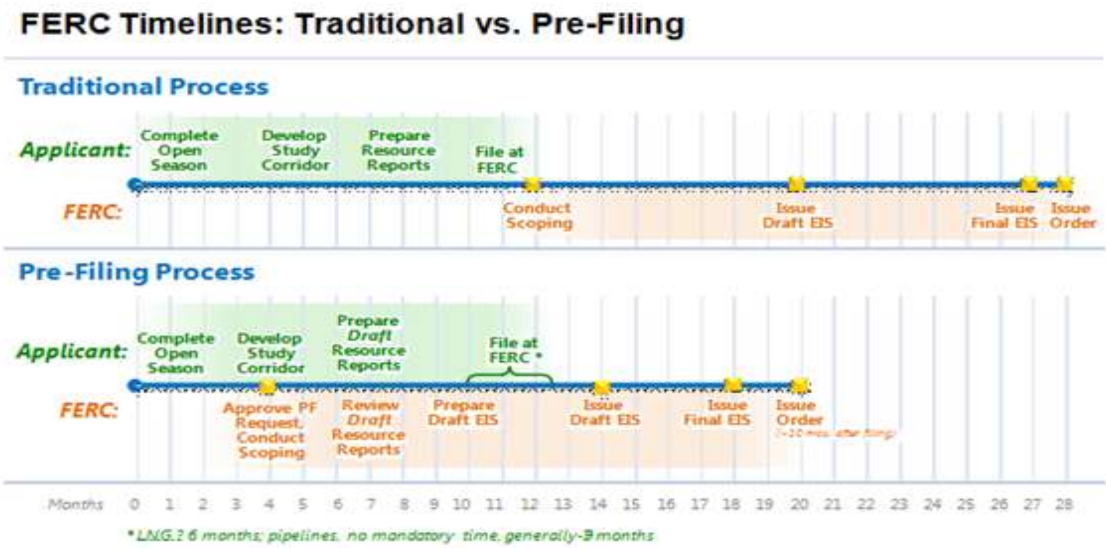


Figure 1 – FERC Timelines: Traditional vs. Pre-Filing Process for Major Projects

Construction of a FERC-jurisdictional pipeline project is the result of a long and thorough planning and evaluation process. That starts with a pipeline company perceiving a need for more natural gas within a certain market and determining that a new pipeline is needed to serve that market.

1.1 Needs Analysis

The first step in a pipeline construction project is identifying a need or “demand” for natural gas transportation or pipeline capacity. The need may include providing new or increased natural gas supply to a market region for a local distribution company (LDC)’s growing customer load, a new gas-fired electric generating plant, or the need to move natural gas from a new gas-producing supply region that does not have enough existing pipeline capacity. Pipeline operating companies often hold non-binding open seasons (explained below) to determine if adequate need for the gas transportation exists.

For smaller projects, need often relates to providing service to a specific end-use customer (e.g., a new pipeline lateral project that expands off an existing pipeline system and connects with a power plant), system optimization (e.g., a small looping project along an existing pipeline facility that creates additional pipeline capacity), or pipeline integrity maintenance projects (e.g., pipeline operators conduct an excavation of the existing pipeline to examine the condition of a section of pipe and, if needed, repair or replace the pipe and/or coating).

Part of the needs analysis usually includes identifying necessary facilities, evaluating both preferred and alternative routes, determining the proposed project's rights-of-way and estimating associated costs to determine if the project is economically viable.

1.2 Open Seasons

An open season generally refers to a specific period of time when all those who may be interested in contracting the transport of natural gas, referred to as "shippers" or "transporters," are notified by the pipeline company about a potential pipeline project and given equal consideration to bid on various types of capacity services to be provided by that pipeline.

1.3 Initial Routing Considerations

If enough transportation capacity has been contracted to justify the project, the route selection process begins in earnest. Even at the earliest stages of project conception, many factors must be considered when evaluating routes for a new pipeline, including finding a space big enough to accommodate the proposed pipeline.

A permanent easement typically is about 50 feet wide, and a temporary easement (additional workspace needed during construction) typically ranges from 25 to 75 additional feet of right-of-way width, depending on the diameter of the pipeline, the depth of cover (depth of soil covering the pipeline is specified by the USDOT regulations at 49CFR192) and the predominate terrain and soil type. Typical permanent and temporary right of way space requirements for uplands construction are depicted in drawings 1 and 1A in Appendix B. Larger pipelines generally require more and larger equipment, which often necessitate additional space to operate safely. Certain locations may require even more workspace beyond the temporary easement to accommodate safe and cost-effective construction.

FERC regulations (18 CFR Section 380.15(d)) require applicants to consider the use, widening or extension of existing rights-of-way. These regulations also require applicants to avoid, to the extent practicable, historic sites, national landmarks and parks, wetlands, recreational and wildlife areas. If these sites cannot be avoided, impacts on these areas must be mitigated. Further, avoiding forested areas and steep slopes, minimizing the clearing, maintaining soil stability, disposal of cleared vegetation, avoiding damage to remaining trees and restoring temporary access roads are all required.

In addition to considering where to locate the pipeline, extensive consideration is given to space requirements to construct the pipeline. The ability to construct a pipeline in a safe and efficient manner requires adequate space to excavate a trench, move people and equipment, store spoil and topsoil, string and weld the pipeline, install the pipeline safely and restore the right of way. **The technical basis for space requirements for the right-of-way width and temporary workspace is detailed in Appendix A.** Each company proposing a pipeline project will make a decision about how much construction space it needs based on its project-specific circumstances. These may include population density, environmentally sensitive areas, right-of-way constrictions, and other factors.

The pipeline corridor selected is heavily dependent on the location of the natural gas supply and the location of the end-use markets. Operators then seek to find the best route to avoid or minimize the effects on known sensitive environmental resources, such as wetlands, water bodies, and areas of protected species habitat. They often seek to co-locate their pipeline, which means they seek to build near existing infrastructure or along existing rights of way. The pipeline route also is influenced by special-use or designation lands (parks, wildlife management areas, and conservation areas), and areas of high population density. Typically, a wide corridor is viewed and studied at the start of a project and subsequently narrowed down as routing impacts are understood. Possible co-location opportunities include existing pipelines, electric power lines, roads or other existing linear infrastructure.

Obstacles to be avoided, if possible, can be geographical (large rivers, lakes, mountain ranges), manmade structures, population centers, highways, or environmentally sensitive or protected areas (national forests, wilderness areas, or endangered species habitat), and locations with known historical or archeological significance. It is important to note that new, improved horizontal directional drilling (HDD) construction technologies have allowed pipelines to be constructed many feet beneath bodies of water when conditions permit.

If a pipeline operator seeks to build a pipeline parallel to an existing pipeline, a resource available to them is the INGAA Foundation Guidelines on Parallel Construction of Pipelines, December 2008, Version 1—see appendix C. These Guidelines recommend that operators contact the existing pipeline(s), establish designated contacts, jointly conduct preconstruction planning and review meetings to coordinate safe construction.

1.4 Corridor Analyses

After an operator identifies potential corridors, it conducts high-level evaluations of the alternatives to determine which alternative(s) should be explored further. The evaluation also includes assessment of potential environmental consequences and the approximate construction costs for the various corridors and potential right-of-way alternatives.

At this phase of the project, the assessment is based largely on known, publicly available information without the benefit of a detailed, on-the-ground investigation.

Usually one or two study corridors are selected from the assessment for further refinement and economic evaluation. Limited reconnaissance consisting of on-the-ground observations using public roads and/or aerial photographs or satellite imagery/Geographical Information Systems (GIS)/aerial reconnaissance, is used to:

a. Narrow the route corridor;
b. More closely identify potential environmental and constructability issues; and
c. Provide information to be used to generate a refined project cost estimate.

When designing system expansion projects that entail either looping (installing additional pipeline beside and connected to an existing pipeline to increase system capacity) or replacement of existing pipe with larger diameter pipe, there usually is a strong desire by the pipeline operator to build near or within its existing right-of-way and other facilities. On the other hand, "greenfield," or new, projects may have more routing flexibility when the pipelines cover long distances.

Most major projects proceed to the voluntary FERC Pre-Filing process (described in the next section), especially if the study corridor evaluation results in one or more of the proposed pipeline routes being environmentally and economically viable.

2.0 Project Authorization and Certification

When FERC issues a certification of public convenience and necessity it allows a pipeline company to construct, operate and maintain the facilities. Maintenance activities such as periodic inspection and testing, repair and other routine maintenance are included in the original authorization and do not require FERC approval. The FERC regulation of interstate natural gas facilities includes a number of different options for how facilities construction can proceed. Installation of certain auxiliary facilities and replacements described in 18 CFR Section 2.55 are exempt from the Natural Gas Act. Auxiliary facilities are those that are used for the sole purpose of obtaining more efficient or more economical operation. These can include valves, pig launchers and receivers, yard and station piping, cathodic protection equipment (an electric current/ sacrificial anode-based system to control erosion), gas cleaning, cooling and dehydration equipment, residual refining equipment, water pumping, treatment and cooling equipment, electrical and communication equipment and buildings.

Other facilities within certain dollar amount and facility type limits are authorized under the Blanket Certificate program described below in section 2.7. Many smaller projects meet these requirements. Other, more significant facilities that are larger or require a more detailed review by FERC under the National Environmental Policy Act and the Natural Gas Act require that an application be filed at FERC and sometimes other agencies. Although some applications can be filed directly to FERC by the applicant, others that have more potential for environmental disturbances and interest by the affected public first go through the pre-filing process.

2.1 FERC Pre-Filing Process

The Pre-Filing (PF) process is mandatory for all major Liquefied Natural Gas projects and associated pipeline facilities. The PF process is voluntary for interstate natural gas transmission pipeline projects although it is strongly encouraged by the FERC for all major pipeline projects. Almost all pipeline operators voluntarily use the PF process for large interstate natural gas projects with potential for significant environmental impact, including those that likely will require an Environmental Impact Statement or "EIS", and many other major projects with less environmental impact, including those that likely will require an Environmental Assessment or "EA" (EAs and EISs are further discussed in Chapter 3.3). The PF process is intended to bring together the operator and affected stakeholders—including landowners, public officials, federal, state or local agencies—to ensure issues are identified and considered by the operator as part of the project-design process so they can be addressed prior to an application being submitted to FERC.

The operator (applicant) files a request to enter PF with FERC's director of the Office of Energy Projects, after having first met with FERC staff to discuss the new project and having notified various relevant federal, and some state and local agencies of the project and getting an acknowledgement from them that they are prepared to participate in studying the project.

Before an operator files its application with FERC, it holds open houses, at which affected stakeholders such as public officials, landowners and agencies learn about the project and are told about potential impacts. The open houses, which are widely advertised, allow stakeholders to discuss the project and voice any concerns with the operator. FERC staff normally attends these meetings to provide information to stakeholders about FERC's review process. This allows the operator to consider comments and permitting issues and to work with stakeholders to mitigate concerns before finalizing and submitting its application to FERC and other agencies. The PF process allows the operator to identify and proactively address issues and potential problems and to collaborate with states, federal agencies, and the people who would be most affected by the new pipeline infrastructure.

FERC will mail information about a proposed project to all affected stakeholders seeking their input on the potential environmental impacts to be discussed in FERC's environmental document (i.e., "scoping"). FERC also may schedule scoping meetings, which are public meetings in various communities to be affected by the project. These meetings bring together pipeline operating companies, various agencies, landowners and other interested parties. The meetings provide a forum for the local community to ask questions and express concerns about the project.

The PF process encourages complete and comprehensive applications that, when filed, can be scheduled for processing by FERC. A projected date for an Environmental Impact Statement or Environmental Assessment and a projected schedule for the issuance of all federal authorizations is then established. This process allows the industry and other agencies to make decisions on a more reliable and predictable basis. Regulatory certainty and a clear timeline for permitting agency decisions is critical to the success of the project. Regulatory certainty leads to cost savings in multiple areas such as gas-supply options, cost of construction, environmental compliance, availability of materials and contractors, etc., all of which can result in cost savings to consumers.

The formal permitting process and the FERC environmental review process begins once an operator (applicant) files its application with FERC for a Certificate of Public Convenience and Necessity (certificate) and other permit applications with appropriate agencies. A more complete explanation of FERC's PF and application review process can be found at www.ferc.gov.

2.2 Pre-Construction Surveys

As part of the public announcement and route planning of the project, the operator will contact landowners (both public and individual/private landowners) about conducting the various engineering and environmental surveys required to finalize the pipeline route within the selected corridor. Depending on state laws, the landowners' permission may be required by the applicant prior to accessing the property for the various surveys. The results of these surveys, and other environmental information collected by the operator, will used as baseline information for FERC's environmental review. Trespassing by pipeline or contractor personnel should be avoided. ; approval by the landowner or duly authorized state agency of court is required for access to the right-of-way.

Survey corridor widths are sized to accommodate likely construction workspace areas, as well as minor adjustments that may be identified to address site-specific constraints or landowner concerns. Survey corridors are typically 300-400 feet wide, but could be much wider in some areas. Corridor widths may be reduced in areas where the project route becomes constrained, such as areas that parallel existing infrastructure. Survey permission required at this phase of the project includes landowners in all corridors being evaluated, some of which ultimately may be unaffected by the pipeline's final location. It is important that landowners grant access to their property for surveys so the operator can determine if conditions are appropriate for the proposed pipeline corridor and so that the company can present accurate information to FERC.

Preconstruction engineering surveys often include:

a. Engineering surveys to identify preferred and alternate pipeline alignments,

b. Subsurface geotechnical surveys to aid in selection of construction techniques at major crossings of rivers, and

c. Roads, railroads and geophysical hazard surveys if earthquake fault or landslide areas are crossed.

Environmental surveys typically include wetland delineation, threatened and endangered species habitat assessment, and cultural resource evaluations (archeological and historic sites). These surveys could involve minimal clearing of vegetation and/or excavation.

Civil surveying includes identification, location and marking of all existing facilities and infrastructure. This enables the operator and constructors to work with landowners to acquire adequate construction space. It also allows pipeline engineers and designers to define where specialized construction methods will be required along the project route, such as near water bodies and wetlands, as well as other areas like hills and steep slopes that pose challenges to conventional construction methods.

The results of the engineering, civil, and environmental surveys are used to provide a detailed analysis of multiple route alternatives to optimize the pipeline's location within the corridor. The final pipeline route is selected to maximize the ease of pipeline construction while minimizing the impact of the pipeline's installation to landowners and the environment.

During the detailed civil and engineering surveys and route identification processes, locations are identified where additional workspace will be required to construct the pipeline safely and cost effectively. Typical sites requiring additional workspace include:

a. Road and railroad crossings,
b. Creek and river crossings ,
c. Locations with ancillary facilities such as block valves or meter settings,
d. Locations where the pipeline must be installed at extra depth to avoid an obstacle,
e. Locations where the pipeline right-of-way has limited access,
f. Locations where special construction techniques are required due to terrain,
g. Locations where pipe and other materials can be stored, and
h. Locations where temporary offices can be established for on-site coordination of the project and communication.

Locations to temporarily store pipeline and construction equipment prior to and during construction also are evaluated and identified. A more detailed discussion of extra workspace determination is included in Appendix A. Detailed civil survey work continues throughout the PF and application process.

2.3 Application to FERC

The formal application filed with FERC includes an Environmental Report that integrates the results of the data collected during the Pre-Filing process. The Environmental Report is broken into 13 specific resource reports that include maps showing the preliminary pipeline route, a description of the proposed pipeline facilities, and an analysis of the environmental impacts associated with the project. These resource reports cover the following topics:

1. Project overview, including construction procedures and a description of planned operation and maintenance
2. Water use and quality
3. Fish, wildlife, and vegetation
4. Cultural resources
5. Socioeconomics
6. Geological resources
7. Soils
8. Land use, recreation and aesthetics
9. Air and noise quality
10. Project alternatives
11. Reliability and safety
12. Polychlorinated Biphenyls Contamination
13. Engineering and design material

Drafts of these resource reports will have been filed with FERC during the PF process, and FERC staff, other agencies and the public will have been given the opportunity to review and comment on them.

The applicant is required to include in the Environmental Report the status of all environmental permits that are required for the project. The number of permits required by federal, state and local jurisdictions can be substantial. The federal and state regulatory process is designed to give specific review to issues (e.g., route crossings of federal land) commensurate with the details of the project route.

Projects are subject to a comprehensive review including various permits and clearances. These permits and clearances address natural resources affected by the project, including land, air, water, vegetation and wildlife, as well as the interests of the general public. The types of permits or other approvals can include:

A. Federal

1. Certificate of Public Convenience and Necessity (*FERC*)
2. Native American tribal lands *(Bureau of Indian Affairs)*
3. Special conditions required by public land agencies (*U.S. Forest Service, Bureau of Land Management)*
4. Wetlands preservation and crossings *(U.S. Army Corps of Engineers)*
5. Streams and rivers *(U.S. Army Corps of Engineers)*
6. Threatened and endangered species *(U.S. Fish & Wildlife Service)*
7. Air emissions *(U.S. Environmental Protection Agency, where not delegated to the state)*
8. Interstate highway crossing permits (*Federal Highway Administration*)
9. Water permits (*U.S. Environmental Protection Agency, where not delegated to the state*)

B. State

1. Land *(erosion and sedimentation permit)*
2. Water *(Hydrostatic Test Water Acquisition and Discharge Permit, Storm Water Discharge Permit)*
3. Stream and river crossings *(State environmental agency)*
4. Cultural resources preservation *(State Historic Preservation Office)*
5. Threatened and endangered species preservation *(State Fish & Wildlife Agency)*
6. Air emissions *(State Environmental Agency)*
7. Special conditions required by public land agencies *(State Forests or other state*

held lands)

8. State and local highway permits

To obtain each permit, the pipeline operator must:

a. Plan,
b. Engage in initial discussions and consultations,
c. Gather required data and information,
d. Complete applications and reports,
e. Communicate with agency staff, and
f. Address questions from agency personnel and achieve approval for each.

The applicant also will need to coordinate with county and municipal agencies, and with appropriate non-governmental special interest groups.

2.4 FERC Environmental Review and Authorization Process

As noted earlier, FERC has the authority to approve the pipeline location and construction and is the lead federal agency for environmental review of the project under NEPA. NEPA, signed into law on January 1, 1970, establishes national environmental policy and goals for the protection, maintenance and enhancement of the environment and it provides a process for coordinating and implementing these goals within federal agencies.

FERC's responsibility as lead federal agency for NEPA review was designated in the Energy Policy Act of 2005 (EPAct05), which also assigned FERC the responsibility to coordinate with and set a schedule for all other federal NEPA authorizations. To implement NEPA requirements, FERC conducts an independent review of the project's anticipated environmental impact in an Environmental Assessment (EA) or an Environmental Impact Statement (EIS).

When the environmental and other FERC public interest reviews are completed, the entire record is considered by FERC's commissioners. Commissioners must decide, after a thorough review, whether to issue a certificate. This review includes an evaluation of need for the project, costs of transporting natural gas by the pipeline, financing and market competition.

Even after FERC issues a Certificate, several additional activities, as described in Sections 2.5 through 2.7, typically are required before FERC will issue a notice to proceed and construction can begin. These activities can add weeks or months between the issuance of the certificate and the commencement of construction.

2.5 Right-of-Way Acquisition

A. Landowner Negotiations

As an operator prepares to implement a project, it obtains legal rights to the land along the proposed route from landowners. The legal right is called an "easement" and the land encumbered by that easement is called a "right-of-way." There are usually two types of easements—temporary (area used only during construction) and permanent (area maintained for the life of the facilities). The cornerstone of the right-of-way acquisition process is the negotiation of an easement agreement between the operator and the landowner. These agreements cover key issues such as compensation, restoration of the land and potential limitations on future use of the land. Operators are required to obtain easements before beginning construction.

A right-of-way agent (also known as a land agent) representing the pipeline company contacts each affected landowner along the route to discuss the project and negotiate an easement agreement.

One of the purposes of an easement negotiation is to establish an understanding between a pipeline company and a landowner on the need for workspace, additional temporary workspace, separation from other pipelines and utility infrastructure, and overall right-of-way width. The easement agreement will specify all the workspace requirements for construction, and outline the company's rights on the right-of-way during operation and maintenance.

INGAA and its member companies are committed to leading the natural gas pipeline industry in building and maintaining strong, positive relationships with landowners. To that end, INGAA has endorsed "*America's Natural Gas Transporters' Commitment to Landowners*." The brochure, which is available on INGAA's website (www.ingaa.org), is summarized below:

INGAA member companies embrace the following commitments:

1. **Respect and Trust**

   Positive, lasting relationships are built on mutual respect and trust. We will strive to understand issues from the landowners' perspective and help them understand ours.

2. **Accurate and Timely Information**

   We will provide landowners with information regarding the importance of energy infrastructure, the reason and need for the proposed project, and the processes in place governing easement acquisition, certification, construction, operation and maintenance of our facilities, and the details of individual projects.

3. **Negotiate in Good Faith**

   We will listen and strive to understand, and negotiate in good faith. We will make every attempt to reach agreement with landowners in an honest, fair and reasonable way.

4. **Respect the Regulatory Compact**

   Final approval for a project is not a certainty and our interactions with landowners will reflect that understanding. Prior to a FERC decision, actions taken to negotiate easements or options are at the company's risk; there is no guarantee the project will be approved. We will communicate clearly that federal eminent domain cannot be exercised unless a Certificate is granted by FERC, and we will distinguish clearly when, and if, eminent domain is exercised pursuant to state law.

5. **Responding to Issues**

   We will respond to landowner concerns in a timely fashion. To enhance direct communications and timely responses, we will provide landowners with a single point of contact within the company to answer any question or concern and to provide general or project-specific information.

6. **Outreach**

   We will engage with and promote awareness on the part of affected stakeholders early in the planning process. In broadening our outreach, we will develop relationships with, and introduce our industry to, those who might not have otherwise known about its benefits to the community and our dedication to safely providing these services.

7. **Industry Ambassadors**

   Each company employee and representative is an ambassador for the industry. We will ensure our employees and representatives interact with stakeholders in accordance with these commitments.

8. **Ongoing Commitment to Training**

   We believe in continuous improvement in all aspects of our business. With demand for natural gas increasing and many new people entering the industry, we will train our representatives to interact positively and productively with landowners and other stakeholders.

A landowner normally is compensated based upon a percentage of fair-market value of the land contained in the permanent easement and temporary disturbance, which typically allows the landowner continued use and enjoyment of their property with some limitations. A standard limitation is that structures and trees usually are prohibited within the permanent easement to preserve safe access of maintenance equipment, when necessary and to allow for unimpeded aerial inspection of the pipeline system.

Landowners also are compensated for the limited use of the temporary easement and any construction-related damages or losses, such as loss of crop revenues or timber production.

The operator will attempt to acquire as much of the right-of-way as possible through negotiation prior to FERC's issuance of a Certificate, so construction can begin after conditions in a Certificate have been met and a Notice to Proceed is issued. This helps pipeline companies meet the in-service target date.

B. Eminent Domain

In some cases, a landowner and an applicant are unable to reach agreement on the terms of an easement. Sometimes there are legal impediments to obtaining an easement, such as when the landowner cannot be found or the property is in probate. If this happens and FERC has determined there is a public need for the pipeline, the FERC Certificate allows the operator to seek access to the land through eminent domain proceedings (the right of the government to take private land for public use). This same right usually is granted under state, and sometimes federal, law to electric and natural gas utilities, telecommunications companies, railroads and other transportation infrastructure.

For interstate natural gas pipelines, the right of eminent domain is granted under the Natural Gas Act, the law governing interstate natural gas pipelines but only when a certificate is issued by FERC. State or federal courts then supervise the fair compensation and treatment of the landowner, following state procedural law.

In some states, an operator pursuing a FERC-regulated project can use state eminent domain laws and rights to obtain the right of access for surveys and/or easements. In those cases, an operator may decide to use the state procedures consistent with the provisions of that state’s eminent domain law. Regardless of whether federal or state eminent domain authority is available to the pipeline company, this is a process of last resort and used only when the company has exhausted all other reasonable means of voluntarily obtaining an easement.

In some cases, a landowner may seek to avoid an eminent domain proceeding, but still use the court system to determine fair compensation. In these cases, the parties enter into a “Right of Entry” agreement, allowing the operator to construct, while still preserving the landowner’s rights to a fair compensation hearing.

2.6 Notice to Proceed

Pipeline construction does not necessarily begin after FERC issues a Certificate authorizing a project. To obtain a final Notice to Proceed with construction from FERC, the operator must file a final detailed Implementation Plan identifying how it will comply with all the construction and mitigation measures it proposed and all requirements of the FERC Certificate, and show evidence that the project has obtained all the required federal permits and clearances.

2.7 Blanket Certificate Process

FERC may issue a company-specific “blanket” certificate that allows an interstate natural gas company to undertake an array of small projects and routine activities without the need to obtain a case-specific Certificate for each individual project as discussed in the previous section.

The blanket certificate program provides an administratively efficient means to enable a company to construct, modify, acquire, operate and abandon a limited set of natural gas facilities. Each activity must comply with the limits on costs and environmental impacts set forth in FERC regulations.

FERC has produced a brochure, “Blanket Certificate Program: Notice to Landowners,” that provides additional information on the blanket certificate program. The brochure is available on FERC’s website (http://ferc.gov/for-citizens/citizen-guides.asp).

The blanket certificate program establishes two tiers of projects: those that require notice to FERC before construction (i.e., prior-notice projects) and those that are automatically authorized. For prior-notice projects, FERC requires an application containing an abbreviated environmental report and copies of all applicable agency clearances to be filed with FERC for a 60-day public review period during which protests may be filed. Construction may not commence until the review period has ended and any protests are resolved. For projects that can be automatically authorized, the operator must provide advance notification of the project to landowners, have all applicable agency clearances in hand before beginning construction, and include information about the project and applicable agency clearances in an report that is submitted annually to FERC.

3.0 Overview of Construction

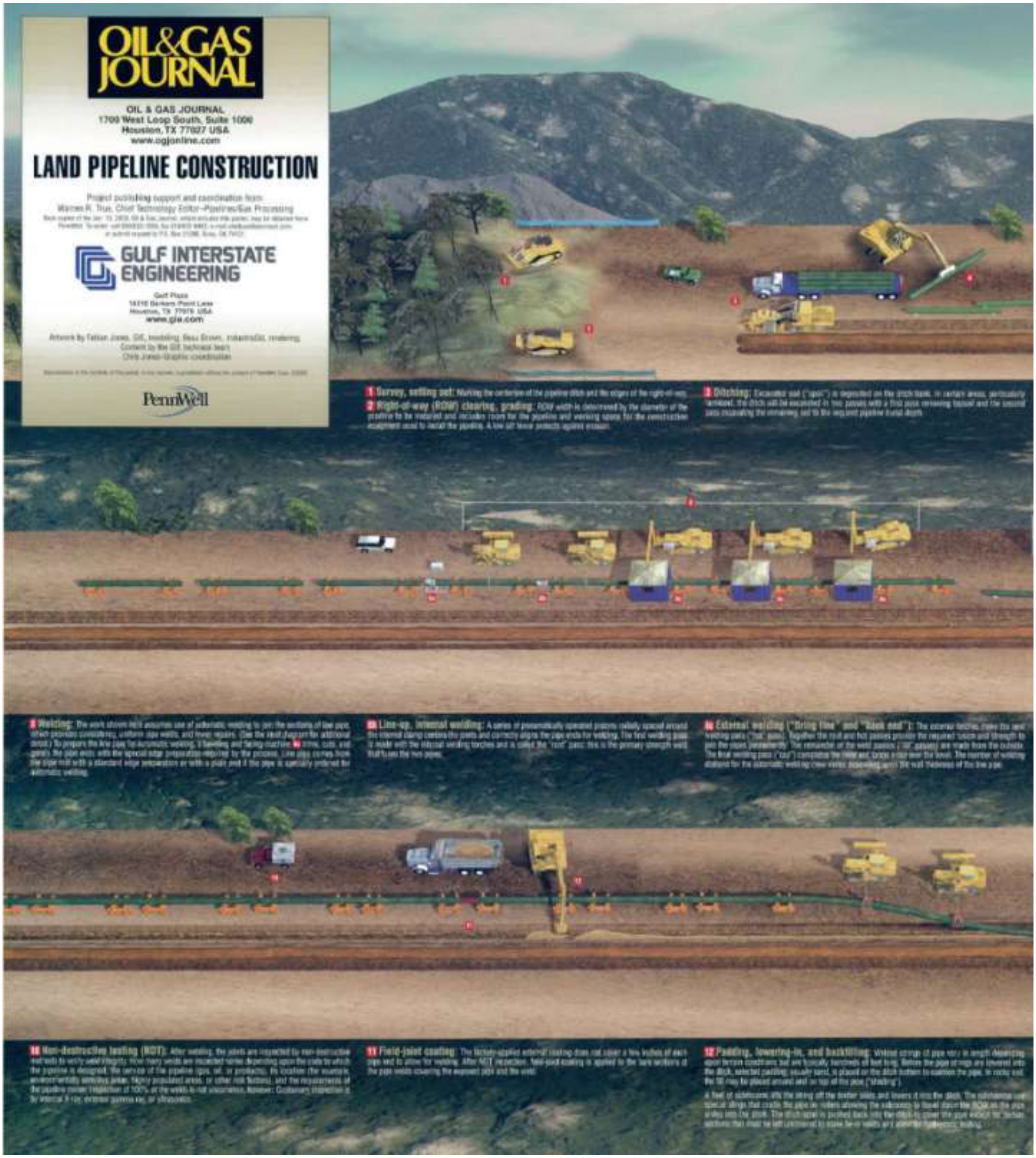
Construction projects can vary in size, ranging from a few mile-long lateral or looping project to a thousand-mile long-haul pipeline that will transport gas from a supply basin to large population centers Regardless of the length, construction of a pipeline progresses through similar stages. The various stages of construction are shown in Figure 2.

A typical interstate, long-haul (long-distance) pipeline project is constructed in manageable sections known as construction spreads that use highly specialized and qualified work crews. Each crew has its own set of responsibilities. Construction spread lengths and crew sizes are determined by a number of factors,
including seasonal restrictions, project and commercial requirements, construction complexity (terrain, rock, congestion with other facilities, amount of road/utility crossings, etc.), land use and environmental considerations (wetland and water bodies, migratory birds endangered and threatened species, fisheries, etc.).

Crews are formed to perform specific tasks or projects, including clearing and grading, welding, inspection, and other construction-related tasks. These crews build the pipeline in sections much like a moving assembly line. As one specialized construction crew completes its work, the next crew will move into position to complete its portion of the construction process. Additionally, facilities such as compressor stations are often considered separate spreads.

On a long-haul pipeline project, there could be 600 to 700 people working at the peak of the construction activity. A typical activity crew might consist of 15 to 20 people in any one area.

Figure 2 – Land Pipeline Construction



8 Automatic welding
9 Horizontal directional drilling
4 Stringing:
5 Bending:
6 Road crossing:
7 Skidding the pipe:
13 Tie-in welding:
14 Hydrostatic testing; final tie-in:
15 Final clean-up, ROW restoration:

In the Primer sections that follow, each step in the construction process (Figure 2) is described in detail. Each section provides a description of what the step entails, how the work is done, including types of equipment used and why operators and their contractors do what they do. **Each step in the construction process requires a commitment to worker safety, the safe operation of equipment, respect the landowner's property and protection of the pipeline and appurtenances being installed.**

Although this Primer focuses on typical long-distance construction, the general construction sequence and processes are the same for large or small projects. The primary difference for the small projects is that the size of work crews and equipment would be scaled down accordingly.

3.1 Design of Line Pipe and Equipment Needed

The American Petroleum Institute (API) and the American Society of Mechanical Engineers (ASME) establish standards for engineering and design to ensure the safe construction and operation of industrial facilities. The standards for natural gas transmission pipeline systems, ASME B31.8, ensures that pipelines engineered, designed and constructed with modern materials and practices can be expected to provide safe and reliable service for many decades when maintained properly. For example, pipelines designed and constructed in the 1930s using steel and coatings that met API and other consensus standards in affect at the time of construction remain in service today. Interstate pipelines utilize integrity management programs designed to ensure that pipelines are maintained and operated in a safe and reliable manner

Pipeline operators use a comprehensive quality management system (QMS) to addresses all phases of the engineering, design, material specification and procurement, shipping, construction and commissioning processes. Material and manufacturing quality management programs ensure that pipelines and pipeline appurtenances (materials or accompanying parts of the pipeline) meet the requirements of international consensus standards for manufacturing including API, Specification for Line Pipe, referred to as Specification 5L, API 6D for valves, among others. The objective is to ensure that the pipe has tensile properties, a chemical composition and fracture control properties that conform with:

a. International consensus-based standards with mill and source-specific specifications ,
b. Quality control measures used by the pipe mill, and
c. Quality assurance used by the purchaser.

The objectives are to ensure that any inclusions and laminations from the solidification process while the pipe hardens will not adversely affect the final pipe performance, and that the pipe dimensional tolerances such as out-of-roundness and straightness will not adversely affect field welding. Materials and manufacturing quality management programs draw upon the standards and specifications mentioned above and are comprised of four steps:

1. Pipe manufacturing mill qualification,
2. Pipe standard, specifications and contracting agreements,
3. Pipe manufacturing procedure specification review and agreement, and
4. Surveillance and auditing.

Typically, a pipeline operator first engages in a technical evaluation of the mill to ensure that the mill is qualified to produce pipe to the operator's specifications. The operator will establish a pipe specification knowing the requirements of the project for which the pipe is being procured. The mill knows best how to source the steel and roll and weld the pipe to meet the performance parameters required by the operator.

The mill and operator then develop and agree upon a manufacturing procedure specification (MPS) that establishes the materials specification to certain standards, types and frequencies of inspections, and how exceptions are to be addressed. The MPS helps identify issues before they become problems. At this time, the pipeline operator also sets forth any additional requirements and manufacturing procedures as well as quality control/quality assurance (QC/QA) practices in a quality assurance plan (QAP), also referred to as an inspection and test plan (ITP).

The 44th Edition of API 5L, Specification for Line Pipe, effective as of October 1, 2008 included an appendix (Annex B), Manufacturing Procedure Qualification for Product Specification Level 2 (PSL 2). It provides a framework for operators to use in working with manufacturers to establish a quality control and quality assurance for pipe specification and manufacturing.

3.2 Construction Survey

Before any construction can begin, a civil survey crew carefully surveys and places markers along the construction right-of-way to ensure that only the pre-approved construction workspace is cleared. After right-of-way easements have been obtained, the pipeline centerline, construction right-of-way and additional temporary workspaces also are surveyed and staked. It is critical that survey crews accurately mark the construction right-of-way and access roads to ensure that only areas for which permits were obtained are cleared.

The operator, its delegate or the construction contractor contacts the appropriate state One Call systems (a nationwide 'Call Before you Dig' system that is accessed by dialing 811) to have existing underground utilities located, identified and flagged to prevent accidental damage during pipeline construction. Sensitive resources such as wetland boundaries, cultural resources, and any areas of protected species habitat also are marked at this time.

In locations where the route parallels an existing pipeline, it is anticipated that the new pipeline operator and the constructor will engage the existing pipeline operator and use the INGAA Foundation, Guidelines on Parallel Construction of Pipelines, December 2008, version 1. See APPENDIX C. Consistent with these guidelines, survey crews will ensure that "marks" (locations) of existing facilities are established prior to and maintained during construction. Experience indicates that this entails re-marking during construction as wind, precipitation and vandals are known to move, remove or otherwise compromise markers.

Crews may install temporary fences to prevent livestock from entering the right-of-way, and to prohibit or otherwise control public access across the right-of-way. This work includes installing new posts to brace the areas on either side of the proposed cut to avoid damage to any existing fence or wall. Temporary gates are installed, as necessary. As specified in easement agreements, access around the construction areas may be provided for landowners.

3.3 Clearing and Grading of Right-of-Way, and Erosion Control

A clearly defined right-of-way free of objects and obstructions is critical to pipeline operators during construction and during subsequent operation. Construction right-of-way and extra temporary workspaces are cleared and graded, where necessary, to provide access for trench-excavating equipment and the movement of other construction equipment and materials, with the primary objective of enabling safe construction. Clearing also is done on approved access roads to provide ingress and egress from public and private roadways.

While a relatively level surface is ideal for construction activities, natural drainage patterns are preserved to the extent possible. Generally, brush, trees, roots, and other obstructions such as large rocks and stumps are cleared from all construction work areas. Non-woody vegetation—such as crops and grasses—in areas where grading is not required are mowed to avoid damage to root systems.

Brush and tree removal is limited to the right of way to protect adjacent properties. Timber is removed only where necessary for construction purposes, and any marketable timber is cut to standard lengths and stacked at the edge of the right-of-way or removed, based on landowner agreements.

Cleared woody debris is chipped and left in place, burned, or otherwise disposed of according to local restrictions, regulatory requirements and landowner agreements. Any burning is conducted in a manner that minimizes fire hazard and prevents damage to surrounding vegetation. These types of activities are restricted or prohibited in wetlands.

FERC's Wetland and Waterbody Construction and Mitigation Procedures (Procedures) and the FERC's Upland Erosion Control, Revegetation and Maintenance Plan (Plan) serve as the resources for management of right-of-way and environmental matters during construction and post-construction mitigation and monitoring. They can be found at http://ferc.gov/industries/gas/enviro/guidelines.asp.

Alternatively, operators may file for and obtain FERC approval of project- or company-specific measures that vary from the FERC Plan and Procedures. When approved, such alternative measures must be demonstrated to provide equal or better environmental protection and be necessary because the associated FERC requirement is infeasible or unworkable (e.g., due to site-specific factors).

Topsoil is stripped (dug up), segregated and preserved according to the operator's plans and procedures in residential areas, actively cultivated or rotated croplands, pastures, hayfields and other areas where requested by a land management agency or landowner. Topsoil is removed to its actual depth, up to a maximum of 12 inches, and stockpiled separately from the subsoil that will be excavated from the pipeline trench, as described later in this document. Topsoil is stripped from directly over the pipeline ditch and the adjacent subsoil spoil storage area. Subsoil removed from the ditch is referred to as spoil. In some circumstances, topsoil may be stripped across the full construction work area.

Segregation of topsoil maintains soil fertility and preserves the native seed bank. Segregation helps to avoid topsoil and subsoil mixing and compacting, both of which can reduce soil productivity. It also facilitates timely restoration.

To contain disturbed soils in upland areas and minimize the potential for sediment loss to wetlands and water bodies, temporary erosion controls are installed immediately after initial soil disturbance and maintained throughout construction. Erosion and sedimentation control devices are installed in accordance with the operator's plan and any state, county or parish requirements for the control of storm water during construction. Silt fencing, hay bales, and water diversion terraces are common methods used to prevent erosion and sedimentation that are required by environmental permits. Environmental monitoring and compliance is an important part of the construction project during its entirety.

3.4 Trenching

Pipelines typically are installed below ground to protect the pipeline and enable continued surface use of the right-of-way. A trench is excavated using heavy equipment to provide sufficient space to enable the pipeline to be moved over and lowered into place, and to provide protection from excavation damage. Excavated materials, primarily soils referred to as spoil, are normally stored on the non-working side of the trench, referred to as the spoil side, away from construction traffic and pipe assembly areas.

Where trenching for new pipelines occurs in proximity to other pre-existing pipelines, care is taken to protect the existing pipeline. Where a new pipeline is co-located with and parallels existing pipelines, spoil may be placed on the same side of the trench, but not directly over the existing pipeline to prevent equipment from operating on top of the in-service pipeline. Where a new pipeline crosses existing pipelines or otherwise encroaches near existing pipelines, precautions are taken to precisely locate the existing pipeline(s) and then safely excavate and expose the existing pipeline so the new pipeline may be constructed safely.

Trenches are typically excavated using rotary wheel ditching machines, track-mounted backhoes, or similar heavy equipment. Local terrain and geology dictate the methods and equipment used to excavate the trench. More challenging terrain and geology may require using trench excavators, rippers, hydraulic hammers, rock saws and controlled blasting.

Temporary trench plugs (barriers in the trench) are used to create segments within the open trench to reduce water flow along the trench and subsequent erosion, and to allow access across the trench. Trench plugs typically are made of either compacted subsoil or sandbags placed across the ditch (soft plugs) or are short, unexcavated portions of trench (hard plugs). Trench dewatering between trench plugs also may be required along portions of the route.

Trench width at the surface is established to ensure that the trench stays open during construction and to provide a safe working environment for construction activities. Widths are dictated by soil conditions, safety practices and local requirements. The base of the trench is excavated at least 12 inches (six inches on each side) wider than the diameter of the pipe to be installed, and the sides of the trench are sloped based on the stability of the soils encountered. The excavated trench must allow space for the pipeline, pipeline bedding, and the minimum amount of top cover required by the U.S. Department Of Transportation's (DOT) Pipeline Hazardous Materials Safety Administration (PHMSA) regulations (at 49 CFR 192.327, Cover). Ground cover over the pipeline provides a protective layer to minimize excavation damage from equipment used on the surface. Placement of pipelines below ground is an essential part of managing the integrity of the pipeline and it enables cathodic protection systems that will be installed later to protect the pipe from corrosion.

The trench typically is excavated to a sufficient depth to enable the proposed pipeline to be installed at least 30" (measured from the top of the pipeline) below the ground surface, in conformance with the DOT-PHMSA regulations cited above. Installation depth is typically greater in agricultural areas to reduce conflicts with cultivation and tilling. Depths in these locations usually are at least 12 inches deeper to achieve a cover depth of 48 inches, but they can be even deeper, if agreed upon with the landowner.

A pipeline also may be installed deeper than minimum depth requirements to provide for the safe crossing of a feature such as a road, highway, railroad, or water body. At crossings of utilities or other pipelines, the proposed pipeline generally is installed at a greater depth to provide for a minimum clearance of 12 inches, or at a depth that may be required by state or local regulations, whichever provides greater protection.

If large quantities of solid rock were encountered during trenching, the constructor uses special equipment such as rock trenchers or rock saws, or explosives to remove the rock. Explosives are used with careful planning and established procedures in accordance with state and federal guidelines to ensure a safe and controlled blast.

Special construction techniques are used to minimize any potential effects of blasting. The handling, transportation, storage and use of explosives are conducted by licensed blasting contractors in accordance with applicable regulatory requirements. To avoid damage, the blasting contractor conducts appropriate preconstruction geotechnical investigations. Any required blasting is conducted in accordance with pertinent regulations and the blasting plan FERC typically requires the operator to develop. The minimum amount of explosives necessary to excavate the trench will be used, and protective mats or soil may be placed over the blast area to keep rock and debris from becoming airborne. Warning signs, fences and barricades will be erected as needed. Care is taken to prevent damage to underground structures such as cables, conduits, and pipelines and to springs, water wells, or other water sources. Blasting is conducted during daylight hours and will not begin until occupants of nearby buildings, stores, residences or places of business have been notified.

Any rock excavated during construction is used as trench backfill, but only to the top of the existing bedrock profile. Rock-free spoil is added to the trench prior to the pipe being placed into the trench. Excess rock is removed from the top 12 inches of soil in actively cultivated or rotated crop and pasture lands to ensure that rock size, distribution and density in the construction work area is similar to that in adjacent undisturbed areas.

3.5 Hauling and Stringing

Pipe is rolled and fabricated at a pipe manufacturing plant referred to as a “pipe mill.” Large projects may utilize pipe from several mills. Pipe can be externally coated with protective coating to prevent corrosion at the pipe mill or at a separate location, referred to as a coating plant. Pipe is inspected and then loaded for transportation to the project location by various means of transportation, including truck, rail, barge or ship. The pipe is transported to either a pipe storage yard in the vicinity of the project or strung (laid out) directly onto the project right-of-way. Pipe typically is manufactured in 40 to 60 foot lengths. Some operators specify “double jointed” pipe, which means that two pipe joints are welded at the pipe mill. This reduces the number of welds to be made during construction.

A stringing crew uses specialized trailers and equipment to haul and lift the pipe off the trailers and then place, or string, the pipe onto the right-of-way, making sure not to damage the pipe or its coating. The crew places the pipe at designated locations along the right-of-way to ensure all pipeline design requirements are met. The design requirements will determine the coating type and wall thickness, based on varying soil conditions, geographic features or nearby population densities. For example, concrete coating may be used under streams and in wetlands.

The wall thickness of pipe will increase from its standard design when certain features are crossed. For example heavier weight pipe typically is used in populated areas, at roads, railroads, water bodies, special construction areas, and through horizontal directional drills. Consequently, the pipe must be carefully tracked and carried to these precise locations along the route and ultimately strung out in preparation for being joined by welding. But first, some of the pipe will have to be bent to conform to the terrain before it can be welded together.

3.6 Pipe Bending

While modern steels used to manufacture line pipe are somewhat flexible, pipe bending is necessary at locations along the right-of-way to ensure that the pipe will conform to the trench, and that placement of the pipe in the trench does not induce additional stresses on the pipe.

Once the pipe has been strung, a bending engineer traverses the right-of-way and surveys the topography, which may include hills, creeks, road crossings and other underground appurtenances. Once the pipeline elevation and profile has been determined, a pipe bending crew uses a specialized bending machine to make bends that do not require factory fabrication. These bends allow the pipe to account for changes in the pipeline route and to conform to the shape of the land.

The bending machine uses a series of clamps and hydraulic pressure to make very smooth, controlled bends in the pipe. All bending is performed in strict accordance with ASME design standards (ASME B31.8 and 49 CFR 192.313 Bends and Elbows) and PHMSA pipeline safety regulations to ensure the integrity of pipe is preserved. In addition, a new pipeline must be designed and constructed to accommodate the passage of special instrumented internal inspection tools (49 CFR 192.150). This requirement limits the degree of bending to ensure that these inspection tools can move through the inside of the pipeline without getting stuck in an extreme bend or wrinkle.

Field bends are not always practical, particularly for large diameter pipelines (30-inch and larger). This may include work sites with rough terrain, and insufficient room to store ditch spoil, among others. Engineered factory bends and fittings are used to address right-of-way constraints. They are engineered and fabricated in a specialty shop and then brought on site for installation at the proper location. There are instances when the actual topography and bend angles cannot be determined until actual construction. In these instances, bends and fittings that can be cut in the field are used. These are referred to as "segmentable" bends or fittings. A workshop conducted by the INGAA Foundation in March 2009 identified the need for guidance on the specification, manufacturing and installation of segmented bends and fittings. A joint industry project was formed in 2011 to develop guidance. The work resulted in a three-volume report entitled, Standards for Procurements and Installation of Field Segmented Bends and Fittings, and is available on the INGAA Foundation Web Site-www.ingaa.org.

3.7 Welding

Welding joins the various sections of pipe that have been strung along the trench into one continuous length. The pipe crew uses special pipeline equipment called side booms to pick up each section of pipe, align it with the previous section and make the first part (pass) of the weld. Depending on the wall thickness of the pipe, three or more passes may be required to complete each weld. Welding in this manner is referred to as "stick" welding and is done manually by a welder. The pipe crew then moves down the line to the next section repeating the process. A welding crew follows and completes the remaining passes. Interconnects, crossings and tie-ins are welded manually.

In the last several decades, contractors have used mechanized welding units to move down a pipeline and complete the welding process. Mechanized welding, done to strict specifications under API Recommended Practice (RP) 1104, still requires qualified welders. Qualified personnel are required to set up and operate the equipment to join line pipe along the route. The use of mechanized welding during construction can be seen readily by the presence of the welding shacks shown in the picture below. As noted in Appendix A on space requirements, welding shacks generally do not require added width during construction, but may in some cases. There may be circumstances on larger diameter pipelines (>36 inch) where there will be more space required based on the size of the shacks and the need to allow room to move the shacks along the right-of-way. Larger extra work spaces may be required for equipment staging at start and stop points, and other features along the right-of-way due to the greater space for side boom tractors and equipment required for this construction technique.

Quality-control of welding is conducted using a three-step process. First, each welder must pass qualification tests to make specific types of welds to be used on the job. Second, each welding procedure must be approved for use on that job in accordance with welding standards established by API RP 1104 and ASME Section IX, and incorporated into regulations by PHMSA. Welder qualification takes place before the project begins. Each welder must complete several welds using the same type of pipe that will be used in the project in conformance with the standards. The welds are then evaluated by placing the welded material in a machine and measuring the force required to pull the weld apart. A third quality-assurance test confirms the quality of the ongoing welding operation. To do this, qualified technicians take X-rays of the pipe welds to confirm compliance with quality standards referred to above. The X-ray technician processes the film in a small, portable, onsite darkroom. If the technician detects any flaws, the weld is repaired or cut out, and a new weld is made. A weld quality inspector also may use ultrasonic technology.

The Foundation's March 2009 Construction QA/QC workshop identified the opportunity to improve welding practices, especially on large-diameter pipeline projects. A group of INGAA Foundation members worked together in 2010 and 2011 to develop guidance for pipe crews, welders and welding inspectors. The group produced a report entitled, Training Guidance for Construction Workers and Inspectors for Welding and Coating, which is available on the INGAA Foundation Web Site-www.ingaa.org. A separate working group of INGAA Foundation members evaluated challenges with mechanized welds and developed guidance to ensure that the techniques used in handling welded pipe during construction are accounted for in weld quality control measures. The group developed a report entitled, Best Practices in Applying API 1104, Appendix A, which will be available on the INGAA Foundation Web Site.

3.8 Coating

Natural gas pipelines are coated externally to prevent moisture from coming into direct contact with the steel and causing corrosion. Line pipe typically is coated before the pipeline is delivered to the construction site, and it is delivered with uncoated areas three to six inches from each end to prevent the coating from interfering with the welding process.

After welds are completed, crews thoroughly clean the bare pipe with a power wire brush or sandblast to remove any dirt, mill scale or debris before applying protective coating to the weld areas. Pipeline operators use several different types of coatings for field joints, the most common being fusion bond epoxy (FBE). The crew then applies the appropriate coating and allows it to dry. Before the pipe is lowered into the trench, the coating of the entire pipeline is carefully inspected to ensure it is free of any defects. Coating inspectors examine ("jeep") the entire surface of the pipe, with a technique that uses electric current to detect bare spots or separations of coating from the pipe surface ("holidays"). Holidays are sanded off and new coating is placed on the pipe, and it is re-jeeped. If no new holidays are found, the pipeline it is lowered into the ditch.

Concrete coating may be used under streams and in wetlands. Weighting is applied to manage buoyancy in special circumstances, such as river and wetland crossings.

Valves and appurtenances are coated with either FBE or coal tar.

The March 2009 QA/QC Workshop mentioned above also identified an opportunity to improve coating practices on the portion of the pipe where girth welds have been made. A group of INGAA Foundation members worked together in 2010 and 2011 to develop guidance for coating applicators and coating inspectors. The group produced a report entitled, Training Guidance for Construction Workers and Inspectors for Welding and Coating, which is available on the INGAA Foundation Web Site. A separate working group of INGAA Foundation members evaluated challenges with applying coatings during construction. The group developed a report entitled, Best Practices in Field Applied Coatings, also available on the INGAA Foundation Web Site.

3.9 Lowering the Pipe into the Trench

Prior to lowering the pipeline, the trench is cleaned of debris and foreign material, and dewatered as necessary. Trench dewatering entails pumping accumulated groundwater or rainwater from the trench to stable upland areas. The work is performed in accordance with applicable local, state and federal permitting requirements, as well as the operator's procedures. In rocky areas, the bottom of the trench is padded with sand, gravel, screened soils, sandbags or support pillows to protect the pipe coating. Topsoil is not used as padding material.

As described above, an inspection of the coating via jeeping is performed to ensure the integrity prior to lowering. Any coating anomalies detected are repaired.

The pipeline then is lowered into the trench by appropriately spaced sideboom tractors working in unison to avoid buckling of the pipe and undue stress on girth welds. Larger-diameter line pipe, typically 36-inch and greater in diameter, require the use of at least three side boom tractors. Lowering the pipe introduces some of the largest combined stresses that a pipeline will experience and use of appropriately deployed side booms ensures that the combined stresses remain below threshold levels established ASME.

Trench breakers—typically either sandbag or foam barricades around the pipeline in the trench—are installed at regular intervals, where appropriate, to prevent subsurface erosion and flow of groundwater into the trench. These are installed in the trench when it slopes or encounters steep terrain, crosses water bodies, wetlands, and other areas of surface water or nears surface groundwater. After the pipeline is lowered into the trench and adequately protected, previously excavated materials that were placed in spoil piles are used to backfill the trench, beginning with the subsoil, followed by the topsoil.

3.10 Tie-Ins

Tie-ins are places where line pipe cannot be welded in a continuous process. The following are examples of places where tie-ins are necessary:

a. Road crossings
b. Road bores (slick bores)
c. Horizontal directional drills
d. Water crossings
e. Induction bends
f. Valves and other appurtenances
g. Test sections
h. Interconnects with other pipelines
i. Surface facilities.

These obstructions and appurtenances, when in place, are quite rigid but must be connected with the remainder of the pipeline system. Typically, crews are dedicated to joining the appurtenances into the system by welding as well as applying coating at tie-ins.

3.11 Backfilling

With the pipeline successfully laid in the trench, crews begin backfilling the trench with either a backhoe or padding machine depending on the soil composition. The backfilling crew takes care to protect the pipeline and coating as the soil is returned to the trench.

Soil is returned to the trench in reverse order; the subsoil first, followed by the topsoil to restore the soil to its original profile (condition). In areas where the ground is rocky and coarse, crews screen the backfill material to remove rocks, bring in clean soil to cover the pipeline, or cover the pipe with a material to protect it from sharp rocks. Crews deliver backfill or "shade" it into the trench to ensure that the pipe is supported fully and to protect the pipeline and coating from any inadvertent damage. Trench plugs are used to stabilize surrounding soils and control groundwater flow.

3.12 Testing and Initial Internal Inspections

Before natural gas is transported through a new pipeline, the entire length of the pipeline is cleaned internally using a cleaning device, known as a cleaning pig, to remove dirt and construction debris. As a final quality assurance test before the pipeline is placed into service, the line is then filled with water to conduct a pressure test referred to as hydrostatic testing, or "hydro testing."

Requirements for this test are prescribed in DOT PHMSA federal regulations (49 CFR 192, Subpart J, Test Requirements). Depending on the varying elevation of the terrain along the pipeline and the location of available water sources, the pipeline may be divided into sections to facilitate the test. Each section is filled with water and pressurized for a specified period of time (typically eight hours) to a pressure 10 percent to 25 percent higher than the maximum at which the pipeline will operate when transporting natural gas.

The test pressure ensures that the pipeline has a sufficient safety margin above the operating pressure and identifies any leaks. Once a section successfully passes the hydrostatic test, the water is sampled to ensure that it is safe to discharge at pre-agreed locations as specified in an environmental permit. The water is discharged and the pipeline is dried. To prevent a corrosive environment, it is critical that water is removed completely.

Current federal regulation of pipe diameter in 49 CFR 192.309 requires excavation of dents more than two percent of the pipe diameter. The dents must be repaired or cut-out, if necessary. Criterion for evaluation and removal of dents were spelled out in the ASME Standard for Transmission and Distribution Piping as early as the second edition, published in 1955. The criterion was developed for visual inspection and manual measurement in the ditch. With the advent of in-line inspection (ILI), operators can elect to run ILI tools after a successful pressure test to identify dents or severe ovality that may have been introduced during construction.

Some operators elect to use above-ground tools such as a close interval survey (CIS) and direct current voltage gradient (DCVG) survey shortly after construction completion. After the pipeline is buried in the trench, the DCVG survey and its close relative, the Pearson survey, are used to identify flaws in the coating that may have been introduced during backfilling and grading or through emergence of rocks. The CIS survey is valuable in identifying areas of low voltage potential along the pipeline system and in balancing the cathodic protection system.

3.13 Cleanup and Restoration of the Right-of-Way

The final step in the construction process is to restore the right-of-way and easement land as closely as possible to its original condition. Depending on the requirements of the project, this process typically involves replacing topsoil, removing large rocks that may have been brought to the surface, completing any final repairs to irrigation systems or drain tiles, spreading seed, lime or fertilizer, restoring fences, etc.

Within 20 days of completion of backfilling the trench, all remaining trash, debris, surplus materials, and temporary structures are removed from the right-of-way and disposed in accordance with applicable federal, state, and local regulations and disturbed areas are graded and restored as closely as possible to preconstruction contours. Permanent erosion control measures also are installed during this phase in accordance with approved plans. Topsoil previously segregated from the trench material is spread uniformly across the construction right-of-way and the topsoil and subsoil in these areas and is tested for compaction along the disturbed corridor.

Seeding or replanting of the right-of-way typically begins within six days of final grading. In areas when the operator and landowner have so agreed, the soil is readied and the operator will re-seed or replant in accordance with those agreements, or in accordance with other agreements or plans. To provide permanent erosion control along the right-of-way, all other upland areas disturbed by construction are fertilized, limed and seeded in accordance with Natural Resources Conservation Service Critical Area Planting Specifications or seed mixes specified by the local soil conservation authorities or land management agencies. Wetland areas are not fertilized, limed or mulched unless the operator is directed to do so by state or local regulatory agencies.

The restoration crew carefully grades the right-of-way. In hilly areas, the crew installs erosion prevention measures such as slope breakers, which are small earthen mounds constructed across the

right-of-way to divert water.

Stream banks are stabilized with erosion control fabrics, vegetative plantings, or structural materials. As a final measure, the crew plants seed and mulches the construction right-of-way to ensure the vegetation types and amount of cover are restored as close as possible to its original condition.

Disturbed pavement and other road surfaces along access roads are restored to preconstruction or better conditions, unless otherwise specified by the property owner and approved by applicable regulatory agencies. Likewise, any private or public property damaged during construction, such as fences, gates, and driveways, is restored to original or better condition, consistent with individual landowner agreements.

Pipeline markers and/or warning signs are installed along the pipeline centerline at specified intervals to identify the pipeline location, specify the operator of the pipeline and provide telephone numbers for emergencies and inquiries.

3.14 Environmental Compliance and Monitoring

FERC and land management agency regulations require monitoring during construction to ensure that environmental mitigation is implemented. Ideally, state and local monitors coordinate with FERC.

Environmental monitoring focuses on four key areas:

1. Environmental inspectors and their responsibilities
2. Applicable plans and procedures that are implemented during construction (Spill Prevention Control and Countermeasure Plans. erosion control/storm water pollution prevention plans, hazardous materials plans, unanticipated discoveries plans, etc.)

3. Environmental training provided to construction contractors and staff
4. FERC oversight, including periodic inspections and/or the use and function of FERC third-party monitors

During project construction, environmental inspectors (EIs) are responsible for monitoring and ensuring compliance with all environmental mitigation measures required by the FERC Certificate, the FERC Plan and Procedures, and other applicable permit or regulatory requirements. The FERC Certificate and FERC's Plan and Procedures outline the EI's duties. They include ensuring compliance with environmental conditions attached to the FERC Certificate, the operator's environmental designs and specifications, and environmental conditions attached to other permits or authorizations.

The EIs have the authority to stop activities that violate the environmental conditions of these authorizations, state and federal environmental permit conditions, or landowner requirements. EIs are authorized to order necessary corrective actions.

Operators typically have at least one EI per construction spread, consistent with the FERC Plan. However, the FERC Plan also indicates that the number and experience of EIs assigned to each construction spread should be appropriate for the length of the construction spread and the number and significance of resources affected.

If appropriate, FERC has approved the use of independent third-party environmental compliance monitors that work for FERC staff but are paid via the project proponent. These third-party monitors are in the project area full time and have some limited authority for approving changes to construction plans, such adding extra workspace or variances from the Plan or Procedures. This program can help avoid delays during construction while ensuring compliance and providing FERC with real-time information on construction activities.

4.0 Special Construction Techniques

This primer has discussed general mainline construction techniques for upland areas. It will now focus on specialized construction techniques used under specific circumstances or to minimize construction impacts to specific resources (e.g., streams, wetlands, residential areas, etc.).

4.1 Open Cut River and Stream Crossings

Special construction techniques often are required when pipelines cross bodies of water. Open-cut river and stream crossings as depicted in drawing 22 in appendix B, involve excavating a trench for the pipeline across the bottom of the river or stream to be crossed. Depending on the depth of the water, construction equipment may be placed on barges or other floating platforms to excavate the pipe trench. If the water is shallow enough, the contractor can divert the water flow with dams and flume pipe to allow backhoes, working from the banks or the streambed, to dig the trench.

The contractor prepares the pipe for the crossing by stringing it on one side of the stream or river and then welding, coating and hydrostatically testing the entire pipe segment. Side booms then carry the pipe segment into the stream bed, similar to construction on land, or the construction crew floats the pipe into the river with flotation devices and positions it for burial in the trench. Concrete weights or concrete coating ensure the pipe will stay in position at the bottom of the trench once the contractor removes the flotation devices.

Flume Crossing - This is accomplished by temporarily directing the flow of water through one or more flume pipes placed over the area to be excavated allowing trenching across the water body to be completed underneath the flume pipes without disruption of water flow. This is depicted in drawing 24 in appendix B. Stream flow is diverted through the flumes by constructing two bulkheads, using sand bags or plastic dams, to divert the stream flow through the flume pipes. The bulkheads and flume pipes are removed once the pipeline installation, backfill of the trench and restoration of stream banks is completed. This crossing method generally minimizes downstream turbidity (muddiness caused by stirring up sediment) by allowing excavation of the pipeline trench under relatively dry conditions.

Dam and Pump Crossing - This method involves installing temporary dams, typically constructed using sandbags and plastic sheeting, upstream and downstream of the proposed water body crossing. This is depicted in drawing 23 in appendix B. Following dam installation, appropriately sized pumps are used to dewater and transport the stream flow around the construction work area and trench. Intake screens are be installed at the pump inlets to prevent entrainment (incidental trapping) of aquatic life, while energy dissipating devices are installed at the pump discharge point to minimize erosion and stream-bed scour. Trench excavation and pipeline installation then begins through the dewatered portion of the water body channel. Following completion of pipeline installation, backfill of the trench, and restoration of stream banks, the temporary dams are removed, and flow through the construction work area restored. This method generally is only appropriate for those water body crossings where pumps can transfer stream flow volumes around the work area and there are no concerns about sensitive-species passage.

Whenever possible, pipeline stream crossing construction is done during low-flow periods. Construction during low flows minimizes sedimentation and turbidity, stream bank and bed disturbances, and limits the time it takes to complete in-stream construction. As required under FERC Procedures, perpendicular crossings are used for water bodies where feasible. Disruption to water flow is limited only to what is necessary to construct the crossing. Adequate flow rates are maintained in streams to limit the potential effects to aquatic life. Temporary equipment crossing bridges generally are installed where needed to allow equipment access across water bodies.

Mitigation measures are implemented to minimize impacts to the aquatic environment during construction as described in the FERC Procedures. The duration of in-stream construction is limited to 24 hours for minor water bodies (10 feet wide or less) and 48 hours for intermediate water bodies (greater than 10 feet wide but less than or equal to 100 feet in width). In accordance with the FERC Procedures, excavated spoil is stockpiled in the construction right-of-way at least 10 feet from the stream bank or in approved additional workspace areas. The spoil is surrounded by sediment control devices to prevent sediment from returning to the water body. In-stream trenching across the stream bottom is isolated from upland portions of the trench through the installation of upland soil trench plugs outside of the water body corridor. Use of trench plugs prevents drainage of water and sediment from upland areas into the water body. The trench plugs are removed just prior to lowering in the pipeline. The trench within the water body is backfilled with native material. Water body banks are returned to as near to preconstruction conditions as possible within 24 hours of completing of open-cut crossings.

4.2 Horizontal Directional Drilling

Horizontal Directional Drilling (HDD) is a trenchless crossing method that can help avoid direct impacts to sensitive resources (water bodies and wetlands) or infrastructure (roads and railways) by directionally drilling beneath them. Directional drilling, while not always feasible, avoids excavation of a trench across the bottom of the water body crossing. It is a method considered for longer crossings and requires special geological conditions at the crossing location. Directional drilling involves drilling a hole large enough for the pipeline to be pulled through and accommodate the curvature established by the designers as depicted in drawings 36 & 37 in appendix B.

Before a directional drill can be designed, core samples must be taken on both sides of the crossing to evaluate the underground rock and sand formations. If subsurface conditions support a directional drill, the engineer can design a crossing that establishes the pipeline precise entry and exit point and its profile as it traverses under the water body.

While this drilling is in progress, the line pipe sections are strung out on the far side of the crossing, opposite of the drilling, to be welded. Once welded, the joints are X-rayed, coated, hydrostatically tested, and then placed on rollers in preparation for installation through the drilled hole.

Once the drilling operation is complete, the cutting head is removed and the drill string is attached to the welded pipeline segment. The crew uses the drilling rig to pull the pipeline segment back through the drilled hole, where it is connected into the pipeline on both ends.

HDD installation typically is carried out in three stages: (1) directional drilling of a small-diameter pilot hole; (2) enlarging the pilot hole to a sufficient diameter to accommodate the pipeline; and (3) pulling the prefabricated pipeline, or pull string, into the enlarged bore hole. HDD is less disruptive on the existing environment than any conventional open-trench operations, but HDD is significantly more expensive. There also is a chance that the t HDD will “frac out” (i.e., be unable to maintain the bore hole and have some drilling fluid escape to the surface) or be unsuccessful. To address these potential problems, FERC requires that operators prepare contingency plans in case HDD cannot be completed.

Drilling fluid circulated through the bore during the pilot hole drilling and reaming process is collected at the surface and processed to remove cuttings (rock and soil particles), allowing the fluid to be reused. Excess cuttings and drilling fluid are treated for disposal at an approved location in accordance with regulatory requirements, agreements and permit conditions. The HDD drilling fluids consists of water, bentonite, and possibly other additives that make the drilling mud/fluid easier to flow. Bentonite is a mixture of non-toxic clays and rock particles consisting of about 85 percent montmorillonite clay, 10 percent quartz and feldspars, and 5 percent accessory materials, such as calcite and gypsum.

Even after HDDs are determined to be a viable and preferred crossing method, there are risks, including the potential for, frac-outs, which would need to be aggressively managed, and occasionally second/multiple attempts are required to successfully complete an HDD. A small- to medium-length HDDs can take several weeks to several months to complete. Significant space requirements exist for HDD sites. These are demonstrated in drawings 35-37 in Appendix B and include ATWS at the drill and exit points as well as false right-of-way to string the pipeline out to be pulled through the HDD bore hole.

4.3 Wetlands

Wetlands, defined by the Federal National Wetlands Inventory classification criteria, vary widely because of regional and local differences in soils, topography, climate, hydrology, water chemistry, vegetation, and other factors, including human disturbance. Construction in wetlands usually is avoided if possible; however, there are scenarios when a wetland is crossed to avoid other features such as residential areas or historic property. Laying pipelines in wetlands or marshes requires special construction techniques. Crews place large timber mats ahead of the construction equipment to provide a stable working platform. The timber mats act much like snowshoes, spreading the weight of the construction equipment over a broad area making it possible to operate the heavy equipment on the unstable soils.

Construction across wetlands is conducted in accordance with applicable permits and FERC Procedures, which are designed to minimize the extent and duration of construction-related disturbance within wetlands. The site-specific crossing procedures used to install the pipeline across wetlands varies depending on the level of soil stability and saturation encountered during construction.

During crossing of unsaturated wetlands (those wetlands without standing water or saturated soils), construction is similar to the standard upland construction procedures described above, with the pipeline segment to be installed through the wetland assembled adjacent to the excavated trench as depicted in drawing 6 in appendix B. However, the grading and trenching in the wetland only will occur after the pipe is welded and ready to be lowered into the trench. In unstable or saturated conditions, construction and excavation equipment are placed on temporary work surfaces, and a prefabricated pipeline segment is pulled into position from outside the wetland using the "push-pull" technique. Upon completion of construction, the temporary construction right-of-way and any extra workspaces are restored as close as practicable to pre-existing grade and allowed to revegetate naturally.

Within the right-of-way, woody vegetation is cut at ground level and removed from the wetlands, leaving the root systems intact. Pulling of tree stumps and grading activities are limited to the area directly over the trench line, unless it is determined that safety-related construction constraints require grading or the removal of tree stumps from the working side of the construction right-of-way. Temporary erosion control devices are installed, as necessary, immediately after initial disturbance of wetlands or adjacent upland areas to prevent sediment flow into wetlands, and are maintained until revegetation is complete. If necessary, trench plugs are installed to maintain wetland hydrology as depicted in drawing 33 in appendix B.

Construction equipment operating in wetland areas is limited to that needed to clear the construction right-of-way, dig the trench, fabricate and install the pipeline, backfill the trench, and restore the construction right-of-way. If standing water or saturated soil conditions are present or if construction equipment causes ruts or mixing of the topsoil and subsoil, only low-ground-pressure equipment or normal equipment operating from timber or prefabricated equipment mats may be used.

Topsoil is stripped from the area directly over the trench line to a maximum depth of 12 inches in unsaturated soils and stockpiled separately from the subsoil. The segregated topsoil is restored to its original location immediately following installation of the pipe and backfill of the trench. Materials such as timber mats placed in wetlands during construction are removed during final cleanup, and the preconstruction contours of the wetland will be restored. Any required permanent erosion control measures are installed, and disturbed areas within the wetland are restored in accordance with the project-specific wetland restoration plan that was previously developed in coordination with the appropriate land management or state agencies and FERC. Revegetation is monitored periodically for the first three years following construction, in accordance with FERC Procedures.

4.4 Residential Areas

In the context of pipeline routing and construction, residential areas are generally defined as areas where residential structures are located within 50 feet of the construction work areas, as well as land classified as residential yard, subdivision, and approved planned residential development. Construction through or near residential areas is undertaken to minimize adverse impacts on residents by ensuring that construction and restoration proceeds quickly and thoroughly. Additionally, landowners are notified prior to the commencement of construction, and work hours may be arranged to take landowners' needs into consideration. Site-specific construction plans typically are prepared to depict the temporary and permanent right-of-way, as well as any special construction techniques proposed, for residences located within 25 feet of proposed construction work areas. In general, the contractor maintains access to homes except for brief periods essential for laying the new pipeline. In the vicinity of streets and homes, temporary safety fences usually are erected to limit access to the construction area. The fencing generally extends at least 100 feet along the edge of the construction work area within 50 feet of a residence.

Additional impact minimization and mitigation measures employed in residential areas include:

- **Minimization of Utility Disruption** - The operator notifies homeowners in advance of any scheduled disruption of household utilities and the anticipated duration of the interruption.
  - The operator may invite representatives of local utility companies to be on-site during construction, when necessary, to avoid disruption of utilities to the residence.
  - Attempts are made to avoid septic systems. Where a septic system is unavoidable, repairs will be made to the system as necessary and as soon as practical following the damage to ensure continued use of the system during and after construction.
- **Special Construction Practices** - Stovepipe or drag-section construction (where minimum trench is opened up each day and single sections of pipeline are laid in the trench, welded and immediately backfilled) may be implemented to minimize construction impacts in residential areas on a site-specific basis.
  - Construction workspace is reduced, as practicable.
  - Segregation of topsoil is conducted where appropriate, or as negotiated with the landowner, and soil is tested for compaction following construction.
  - The contractor strives to minimize the time the trench is left open to avoid potential safety hazards.

    - The contractor controls dust during construction by applying water to the rights-of-way, as necessary.
    - Litter and debris are removed daily from the construction site.
    - Restoration of work areas proceeds rapidly after backfilling the trench.
- **Special Restoration Practices** - The operator strives to accommodate any special concerns regarding private landscaping and other potential conflicts with the construction and operation of the pipeline.
    - Mature trees and landscaping are preserved to the extent possible while ensuring the safe operation of construction equipment.
    - Clean up and restoration of residential areas after backfilling is to "as before or better" condition.
    - If construction requires the removal of private property features, such as gates or fences, the landowner or tenant will be notified prior to removal.
    - Following completion of construction, the property will be restored and revegetated as requested by the landowner in accordance with the easement agreement.

These possible mitigation measures are discussed and negotiated between the pipeline company and the landowner.

4.5 Agricultural Areas

When a proposed pipeline crosses agricultural lands, which are defined as actively cultivated and rotated cropland, hayfields, or improved pasture, special construction practices are implemented to minimize impacts to soil productivity and structure. In such areas, it is important to ensure proper depth of cover over the pipe. Depth of top cover is measured from the top of pipe and/or any associated coating. Typically, a minimum of 36 inches of cover will be used over the pipe. Any additional depth of cover for circumstances such as deep plowing, existing surface and subsurface drainage systems or existing permanent erosion control structures (i.e., terraces) will be addressed on a case-by-case basis with each landowner and documented in the easement agreements.

The pipeline company will conserve topsoil in agricultural areas using either the ditch and spoil side or full right-of-way topsoil segregation methods. Usually a maximum of 12 inches of topsoil will be segregated in these areas. Where topsoil is less than 12 inches deep, the actual depth of the topsoil will be removed and segregated. In some cases the topsoil removal depth may be specified at the request of the landowner or land management agency. Soil fertility and other characteristics are often taken into account.

To prevent soil mixing, the segregated topsoil and subsoils excavated from the pipeline trench are stored in separate windrows (long lines of raked hay or sheaves of grain laid out to dry in the wind). Whereas topsoil and subsoil piles resulting from ditch and spoil side topsoil segregation usually can be stored in the nominal right-of-way, full right-of-width topsoil segregation typically requires additional workspace, with up to an additional 25 feet of right-of-way width usually required.

In areas with a predominance of agricultural land or that uses specialized agricultural practices, the applicant may develop a project-specific Agricultural Impact Mitigation Plan (AIMP). If applicable, the applicant works with representatives from various state agencies to develop the AIMP. Sometimes the AIMP will provide for the use of Agricultural Inspectors during construction and on an as-needed basis after construction to monitor restoration and reclamation of the pipeline right-of-way.

Prior to construction, the applicant contacts landowners to locate any existing drainage structures (e.g., drainage tile) and irrigation facilities. The operator works to maintain water flow to crop irrigation systems during construction, unless shutoff is coordinated with the affected parties. Additionally, the operator will restore these structures and facilities to pre-project condition or in accordance with measures requested by, and agreed to with, the landowner. Drainage systems are probed to determine if damage has occurred beyond the ditch line. All tiles damaged during construction are marked in the field and recorded by station number and orientation for future reference. All tiles damaged during construction are repaired to their original condition or better, and records of drainage system repairs are maintained and available for affected landowners' future reference.

The specific measures listed below are implemented during the various phases of construction in agricultural areas.

- Grading:
    - Topsoil is stripped as appropriate (full-width or ditch-plus-spoil side) and then segregated from subsequent subsoil piles;
    - natural flow patterns of fields are maintained by providing breaks in topsoil and subsoil stockpiles;
    - Where deep rutting is likely or could potentially result in topsoil/subsoil mixing, alternatives such as requiring equipment to work on weight-distributing mats and/or timbers are implemented. Alternatively, low ground pressure equipment may be utilized to perform tasks otherwise performed by wheeled equipment
- Restoration and Revegetation:
    - Any rutting or compaction is repaired prior to spreading the segregated topsoil or revegetation of disturbed areas.
    - Rock and stones larger and/or in higher densities than those in adjacent undisturbed areas are collected and properly disposed.
    - Based on landowner agreements, the backfill may be crowned to allow for subsidence such that when the backfill settles it will be near natural grade.
    - Where subsidence is determined to be a result of construction activities, the pipeline company will return and reestablish natural grade in low areas to the extent practical.

Restoration in active agricultural lands is considered successful when surface condition is similar to adjacent undisturbed areas, proper drainage has been restored, construction debris is removed, and revegetation is successful. Revegetation in agricultural areas is considered successful if crop yields are similar to adjacent undisturbed portions of the same field, or if in accordance with landowner easement agreement. In some instances, landowners are compensated for anticipated crop losses resulting from construction of the project for a period of years following construction.

4.6 Construction on Steep Slopes

In areas of side-slopes and rolling terrain along a pipeline route, some portions of the pipeline route may require specialized construction techniques to establish safe working conditions. Construction on steep slopes can be accomplished either along the slope or across the slope depending on the desired and sometimes most feasible route. In either case, steep or side slopes, the stability of the slope is evaluated in selecting the pipeline route.

Construction along the slope usually does not require extra right-of-way width. However, on very steep slopes, for safety and stability, large equipment such as bulldozers at the top of the slope may be connected to excavators and side booms operating on the slope by cable using a winch system.

Side-slope cutting across the face of a slope occurs in rough, steep terrain and in areas where rerouting the pipeline is un-feasible due to mitigating factors such as sensitive-resource avoidance, parallel road ways, existing utilities, etc. Where the pipeline crosses laterally along the side of a slope, cut and fill grading may be required to obtain a safe, flat work terrace. Generally, the construction right-of-way will need to be expanded by an additional 25 feet or more to accommodate side slope construction.

Generally, on steep side slopes, soil from the high side of the right-of-way is excavated and moved to the low side of the right-of-way to create a safe and level work terrace. On more extreme slopes, the working side may entail creation of two levels, or benches, referred to as "two-toning." This is depicted in Drawing 10 in Appendix B. A top level serves as the travel lane. Pipe joints are strung, joined and welded, and girth welds coated and installed in the ditch on a second level below the work terrace. After the pipeline is installed, the soil from the low side of the right-of-way is returned to the high side, and the slope's original contours are restored.

In sloped areas, trench breakers are installed at regular intervals along the trench line to prevent erosion and undercutting of the soils beneath and around the pipeline. In addition, trench breakers are installed at the base of all steep slopes adjacent to water bodies or wetlands.

When disturbed by construction, steep slopes may be susceptible to erosion if water from major precipitation events such as snowpack runoff and intense rainfall events is not controlled. During restoration, permanent slope breakers are installed near the top of a slope, typically within 10 to 30 feet of the crest of a slope, to act as a reference point for spacing the remaining breakers. Spacing of the remaining breakers is determined based on soil type and the degree of slope. Where the ground surface is naturally rocky and resistant to erosion, permanent breakers may sometimes be omitted.

Mulch, where applied, may be crimped or "punched" into the topsoil. Crimping and punching involves a two-pass application of weed-free straw to an area. If mulch is crimped into the surface by a disk, the crimping pattern is cross-hatched to prevent the creation of down slope furrows that could channelize runoff. Mulch will not be crimped in rocky areas. After the first application of mulch and seed is applied, the material is crimped into the soil by hand, or with a disk, or "punched" into the surface with a footed roller pulled by a tractor. Following the first mulch application and seeding/fertilizing, a second layer of mulch may be applied and anchored. In some instances, mulch may be applied and anchored with a tackifier, an additive that helps increase the tackiness of an adhesive.

Erosion control fabrics (*i.e.*, jute matting, straw blankets with plastic netting, or curlex) may be substituted for straw mulch on some steep or unstable slopes, or where mulch cannot be applied by mechanical means because of safety concerns.

Rock mulch also can be used to control erosion in areas that have a native gravel, cobble, boulder or bedrock surface. Rock salvaged and stockpiled from work areas during construction is distributed over the construction right-of-way during restoration and seeded with broadcast seeder. The gaps in the rocks provide an environment beneficial to seed germination by allowing moisture to collect and provide protection from wind. A rock cover also can blend the construction right-of-way into undisturbed areas.

4.7 Road and Rail Crossings

Pipeline contractors use the "open-cut" method when crossing most small roads as depicted in drawings 12 & 13 in appendix B. Traffic is diverted while the contractor digs the trench across the road and installs the pipeline. After completing the crossing, the contractor repairs the road bed and replaces the road surface. Permits from local governments generally are required for road crossing; those permits may address requirements for minimizing traffic disruptions during construction and may require that the pipeline company post a bond for the repair of road beds. Some local governments also require plans describing how traffic will be accommodated during construction.

For highways and major roads with heavy traffic (see drawings 14 – 19 in appendix B), and rail road crossings (see drawings 20 & 21 in appendix B), pipeline contractors often use road bores to install the pipeline. Similar to a directional drill for river crossings, the road bore is accomplished with a horizontal drill rig, or boring machine. The boring machine drills a hole under the road to allow insertion of the pipe. Typically, a dummy pipe section is pulled through which is welded to the line pipe. The dummy pipe is pulled back through placing the line pipe in the crossing. In some instances, a casing (another larger pipe) is installed in the hole and the gas pipeline is inserted inside the casing. Casings typically are not in use today, however, some states require casings on rail crossings. Casings also may be used in soils where it is difficult to pull pipe. The benefit of the road bore is that it allows installation of the pipeline without disrupting traffic.

4.8 Compressor Stations, Metering and Regulator Stations

Construction of the compressor stations involves clearing, grading and compacting the sites to the surveyed elevations—where necessary—for placement of concrete foundations for buildings and to support skid-mounted equipment. Compressor station sites are determined by flow requirements along the pipeline route as well as the size of the compression equipment required. Compressor stations typically are spaced about every 50 to 75 miles along the pipeline route to compress the gas to allow it to flow through the line. Sites may range from just 2-4 acres to over 100 acres when more land is available. Compression and other equipment typically is located on just a portion of the property and the remainder is buffer from nearby properties.

Prefabricated segments of pipe, valves, fittings, and flanges are shop- or site-welded and assembled at the compressor station site. The compressor units and other large equipment are mounted on their respective foundations, and the compressor enclosures are erected around them. Noise abatement equipment—including sound-attenuating enclosures around the turbines, exhaust stack silencers, and air inlet silencers—and emission-control technology is installed as needed to meet applicable federal, state, and local standards. As necessary, electrical, domestic water and septic, and communications utilities are installed.

Excavation is performed as necessary to accommodate reinforced concrete foundations for the new compressors, pigging facilities, metering equipment and buildings. Subsurface piles may be required to support the foundations, depending upon the bearing capacity of the existing soils and the equipment loads. Forms are set, rebar is installed, and the concrete is poured and cured in accordance with applicable industry standards. Concrete pours are sampled randomly to verify compliance with minimum strength requirements. Backfill is compacted in place and excess is used elsewhere or distributed around the site to improve grade.

Turbines, electric motors, compressors, metering and other equipment are shipped to the site by truck. The equipment is off-loaded using cranes, front-end loaders, or both. The equipment is positioned on the foundations, leveled, grouted where necessary, and secured with anchor bolts.

All non-threaded piping associated with the aboveground facilities is welded or connected using flanged components. All welders and welding procedures are done in accordance with API Standard 1104 or ASME Section IX, Boiler and Pressure Vessel Code. All welds in gas piping systems are examined using non-destructive testing, in accordance with applicable codes. All components in high-pressure natural gas service are pressure tested, and all controls and safety equipment and systems, emergency shutdown equipment, relief valves, and gas measurement and control equipment are commissioned prior to being placed in service.

Facility piping, both above and below ground, is installed and hydrostatically (see section 3.12) or pneumatically tested before being placed in service.

Upon completion of construction, debris and waste generated during construction are appropriately managed or disposed off-site at state-authorized disposal facilities. All disturbed areas associated with the aboveground facilities are finish-graded and seeded or surfaced for industrial use (typically covered with gravel or paved with asphalt), as appropriate. All roads, parking areas, and areas around the equipment are surfaced for industrial use, unless a land management agency stipulates otherwise. Additionally, the compressor station sites are fenced for security and protection.

Construction of meter and regulator stations, mainline valves, and pig launcher/receiver facilities not co-located with compressor stations generally occurs in a manner similar to that described above for compressor station sites.

4.9 Material Staging and Contractor Yards

Pipe is normally delivered from its point of manufacture by rail to a rail off-loading yard conveniently located to the construction right-of-way. From there, pipe joints are loaded onto flatbed trucks and taken to pipe staging areas that are temporarily maintained close to the construction right-of-way. Pipe staging areas may be located in nearby cities with rail offloading capability where pipe can be collected and prepositioned. Valves, factory-manufactured bends and other appurtenances are transported by rail or truck from the points of manufacture to the pipe staging areas as well. These areas could be 15 to 30 acres in size. In addition, another 10- to 30-acre area is required for contractor yards that serve as an assembly point for construction crews to meet prior to proceeding onto the right-of-way. Contractor yards also provide space for temporary offices, storage trailers, and fuel tanks.

Multiple pipe staging yards may be constructed to support individual pipe construction spreads. A truck typically carries a maximum of 20 joints of pipe at a time; however, this varies by pipeline diameter, wall thickness, weight, and pipe stacking method. Trucks will make round-trips all day between rail off-loading areas and pipe staging areas until all of the materials assigned to the material areas have been delivered. Pipe staging areas and contractor yards may be in use from 3 to 12 weeks.

4.10 Quality Control and Quality Assurance

Work to be conducted during construction is defined in construction specifications. Historically, construction specifications have been developed by the pipeline owner, and that is often the case today. There are instances, especially with turn-key contracts, when the general contractor will provide owner-approved construction specifications. The governing document for construction is the contract between the owner and the general contractor. The contract refers to the construction specifications. The owner develops and applies inspection guidelines.

Table 2 summarizes consensus standards and guidance documents that are useful in developing specifications and inspection plans. Extensive work and diligence is required to develop quality control measures for each step in the construction process. The table also indicates the way in which inspection is managed during the construction process. "Hold" means that construction does not proceed until the inspection finding is addressed. Witness means that the inspector witnesses the step, and construction proceeds unless noncompliant condition is identified.

The INGAA Foundation has gone further in recognizing the need for quality assurance during each step of construction and has developed a white paper on a quality management system for construction (Overview of Quality Management Systems – Principles and Practices for Pipeline Construction, February, 2012), available on the INGAA Foundation web site. Additional work in this area continues.

Table 2: Quality Control in Construction of Natural Gas Transmission Pipelines

Construction Step	Description	Applicable Consensus Standard	Applicable Regulations	Training/ Qualification	Inspection Frequency	Inspection Type
Preconstruction Planning and Design	Including Corridor Analyses, Initial Surveys and Route Selection	INGAA Foundation Guidelines for Parallel Construction of Pipelines, Rev 1	18 CFR 380.15; FERC's Wetland and Waterbody Construction and Mitigation Procedures (Procedures) and the FERC's Upland Erosion Control, Revegetation and Maintenance Plan (Plan).	Personnel trained and work using procedures	Plans reviewed and approved by FERC	Hold
			49 CFR 192 Subpart G - General Construction Requirements			
Design of Line Pipe and Apurtenances	Design of line pipe, valves, fittings, etc.	Design as per API 5L, 6D. ASME B31.8, MSS-SP-75	49 CFR 192 Subpart C - Pipeline Design	Design bases approved by registered professional engineer	Design basis and documentation subject to review during design and construction and ultimately, PHMSA audit	Review, Witness and Audit Available to FERC and PHMSA staff
	Transport of pipe	Transportation as per API 5L1, 5LW and Company procedures by truck (API 5L is developing RP for truck transport)		Personnel trained and work using procedures	Inspection of loading and unloading on large orders	
	Protection From AC Interference during construction	IEEE Standard 80		Design bases approved by registered professional engineer		
Clearing and Grading of Right-of Way, and Erosion Control		Common Ground Alliance Best Practices	Applicable State One Call Regulations	Locators that also perform O&M tasks are Operator Qualified	Continuously or as needed during clearing and grading; industry leading practice is to have an inspector observing all ground disturbances	Witness, work stoppage when unsafe conditions are deemed to exist
		INGAA Foundation Guidelines for Parallel Construction				
		API 1166 - Recommended Practice on Excavation Observation				

Table 2: Quality Control in Construction of Natural Gas Transmission Pipelines

Construction Step	Description	Applicable Consensus Standard	Applicable Regulations	Training/ Qualification	Inspection Frequency	Inspection Type
Trenching			OSHA 1926.651 - Trenching Requirements	Personnel trained and work using procedures	Continuously or as needed during clearing and grading; industry leading practice is to have an inspector observing all trenching	Witness, work stoppage when unsafe conditions are deemed to exist
			OSHA 1926 Subpart P, Appendix B - Sloping and Benching			
Stringing		ASME B31.8, Section 841.251	49 CFR 192.307 - Inspection of materials and 49 CFR 192.309 - Repair of steel pipe	Personnel trained and work using procedures	Continuously or as needed	Witness, work stoppage when unsafe conditions are deemed to exist
Pipe Bending		ASME B31.8, Section 841.23 and other constraints defined within B31.8	49 CFR 192.313 Bends and elbows	Personnel trained and work using procedures	Continuously or as needed	Witness, work stoppage when unsafe conditions are deemed to exist
Welding	General	API 1104	49 CFR 192.225 - Welding Procedures including Qualification of Procedures; 49 CFR 192.227 - Qualification of Welders	49 CFR 192.227 - Qualification of Welders	Industry leading practice is 100 percent of welds. Regulations require NDE on 10 percent of welds in Class 1, 15 percent in Class 2 and 100 percent in Class 3 and 4, and crossings unless impractical and then 90 percent is minimum.	Hold
	Manual	API 1104				
	Mechanized	API 1104 including Appendix A				
Coating	Corrosion coating of girth welds, and abrasive resistant overlay (ARO) for crossings	Company Coating Specification including min., nom., and maximum	49 CFR 192.461 - external corrosion control; protective coating;	Personnel trained in applying FBE and industrial coatings; given site specific training on job	All coating including girth welds is inspected by jeeping at the end of lowering into trench	Hold
		NACE RP-0394-94				
	Surface cleaning and anchor pattern	NACE No. 1/SSPC-SP 5 or No. 2/SSPC-SP10				

Table 2: Quality Control in Construction of Natural Gas Transmission Pipelines

Construction Step	Description	Applicable Consensus Standard	Applicable Regulations	Training/ Qualification	Inspection Frequency	Inspection Type
Lowering Pipe In Trench	Inspection of coating and pipe prior to and during lowering	ASME B31.8, Section 841.252	49 CFR 192.325 - Underground clearance; 49 CFR 192.461(c) with respect to coating	Personnel trained and work using procedures	Continuously or as needed	Witness, work stoppage when unsafe conditions are deemed to exist
	Inspection of ditch bottom and contour to make sure no stress on pipe	ASME B31.8	192.319(a) to ensure the pipe is protected and minimize stresses			
Tie-Ins	Making welds connecting line pipe to crossings or interconnects to other pipelines	API 1104		49 CFR 192.227 - Qualification of Welders		Hold
Padding	Ensure that padding is provided to prevent damage to pipe from resident rocks and other materials	ASME B31.8	192.319 (a) and (b)	Personnel trained and work using procedures	Continuously or as needed	Witness
Backfilling	Ensuring that coating is not damaged during backfilling and regrading	ASME B31.8	49 CFR 192.319(b) for backfilling requirements and 49 CFR 192.461(c) with respect to protecting coating during backfilling	Personnel trained and work using procedures	Continuously or as needed	Witness
	Provide sufficient cover over the pipeline	ASME B31.8	49 CFR 192.327			
Testing	Pressure testing of the pipeline system	ASME B31.8, and Appendix N	49 CFR 192 Subpart J	Personnel trained and work using procedures	All line pipe is pressure tested	Hold, test failure requires removal of pipe
Cleanup and Restoration			FERC's Upland Erosion Control, Revegetation and Maintenance Plan (Plan)	Personnel trained and work using procedures	As specified in company approved plans	Witness
Environmental Mitigation Monitoring	Ongoing environmental mitigation and monitoring	18 CFR 380.16 - Environmental reports for Section 216 Federal Power Act Permits	FERC's Wetland and Waterbody Construction and Mitigation Procedures (Procedures) and the FERC's Upland Erosion Control, Revegetation and Maintenance Plan (Plan).	Personnel trained and work using procedures	As specified in company approved plans	Witness
Cathodic Protection	Install appropriate number of test stations, design and install CP system	ASME B31.8	49 CFR 192.455	Personnel Operator Qualified and work using procedures	As needed	Witness
Post-Construction ILI and Above Ground Surveys	In-line inspection of pipeline for dents and metal loss, and above ground surveys (such as CIS and DCVG) to identify low potentials and coating damage.	API 1163, NACE RPs define methods and how to implement		Personnel trained and work using procedures	At the completion of construction. Anomalies identified addressed by construction contract can be remediated under cost of contract.	Witness

4.11 Working Atop In-Service Pipelines

It is not desirable for heavy equipment performing construction or integrity management tasks to work over the top of pipelines that are flowing gas (in service). However, it is not always possible to avoid working atop in-service pipelines when doing expansion or maintenance work. Appendix A on space requirements states why extra separation between new and existing pipelines is desirable.

When working atop in-service lines special precautions must be taken to prevent damage to those pipelines. These precautions might extend the time to complete the work, and could require additional devices to be used to protect the pipelines. This could result in higher construction costs. Nevertheless, the overriding goal is to work safely atop these lines and to prevent damage from excessive weight-loading from heavy equipment, cyclical stresses by vibrating equipment and direct contact by excavating and earth moving equipment. Additionally, unintentional damage to other equipment such as rectifier ground beds, wires, grounding systems, anode flex cables, etc. may occur, which could jeopardize measures in place to prevent corrosion of the pipelines.

Work progress may be affected when working atop of buried in-service pipelines because the existing pipelines need to be continuously “marked” and the depth probed to ensure the contractor knows the precise location of the pipelines at all times.

5.0 Post-Construction Maintenance

Pipelines must be maintained appropriately to ensure continued safe operation. Interstate pipelines are subject to periodic, routine evaluation to identify and implement repairs as needed so the pipelines can be operated in a safe and reliable manner.

To comply with Department of Transportation monitoring requirements, vegetation must be managed so the right-of-way can be visually inspected and physically accessed for maintenance and repair. The need for the visual inspection and physical access must be balanced against the environmental objective to revegetate the right-of-way with appropriate species. Therefore, vegetation management procedures are performed in accordance with the FERC Plan and Procedures and include regular mowing, cutting and trimming of the permanent pipeline right-of-way. However, these activities across the full right-of-way width in uplands generally are not performed more frequently than every three years. Full right-of-way maintenance clearing is not conducted in wetlands, but the FERC Wetland Procedure allows certain trees over the pipeline that are greater than specified heights to be selectively cut and removed from the right-of-way. Additionally, a corridor not exceeding the width specified in the Procedures may be maintained annually in an herbaceous state along the length of the pipeline as required to facilitate periodic corrosion and leak detection surveys.

6.0 Summary

The preceding sections described the sequence of pipeline construction. The intent of these sections is to have the reader understand what is done in each step of construction, how it is done, the types of equipment used and why certain practices are used. The “why” is to protect workers, ensure safe operations of equipment, respect landowner’s property, protect the environment and ensure safe installation of the pipelines and appurtenances. Appendix A that follows provides the technical basis for permanent and temporary right-of-way width requirements. Appendix B provides drawings for the most typical construction scenarios, including additional temporary work space.

Appendix A

Technical Basis for Nominal Right-Of-Way Widths, Separation, Workspace and Additional Temporary Workspace

Appendix A

Technical Basis for Nominal Right-Of-Way Widths, Separation, Workspace and Additional Temporary Workspace[2]

The right of way (ROW) width and additional temporary work space (ATWS) requirements for construction of pipelines are directly related to the space required for safe and efficient construction, as well as several project and location-specific factors.

Nominal right-of-way widths are based on:

- 2-3′ of depth of cover
- Type B soils
- Generally flat terrain
- Ditch and spoil side topsoil segregation.

Expanded Right-of-way width for larger diameter pipeline is also discussed below

It's important to note that differing conditions may necessitate additional workspace.

When determining nominal workspace requirements, the pipeline company must consider the space needed for the safest construction possible, personnel safety, staging of pipe and pipeline appurtenances, and efficient movement of materials and equipment.

The Federal Energy Regulatory Commission (FERC) specifies that spoil storage must not overflow from the right of way (ROW) edge onto adjacent properties, and that segregated topsoil and spoil piles must not co-mingle. In general, this requires a two foot buffer zone when piling spoil near the edge of the right-of-way and a one-foot separation between the piles. In addition, ingress/egress workspace is needed for personnel working along the right-of-way (between the pipe string and the trench, and in between equipment) and in conjunction with heavy equipment. These space requirements are described in greater detail in the sections that follow.

Where trenching is done to permit personnel to enter the trench, such as excavations for operations, maintenance and integrity-related activities, the U.S. Department of Labor, Occupational Safety and Health Administration (OSHA) regulations at 19 CFR 1926 define safe practices for excavation, which in turn drive the width of excavations. In addition to minimum wall slope requirements OSHA regulations specify a two-foot setback from excavations to prevent cave-ins or collapse.

[2] See Foreword for a description of the process used to determine space requirements.

1. Workspace comprises four elements: **Permanent right-of-way** location and width requirements, including long-term maintenance and integrity management needs.
2. **Temporary construction right-of-way** for construction equipment and spoil storage (topsoil and subsoil).
3. **Separation** from other infrastructure such as pipelines, power lines, and structures (above and below ground).
4. **Additional temporary workspace** (ATWS) needs, which vary due to terrain, subsoil conditions, and road, rail, wetland, water body and other crossings including horizontal directional drill (HDD) locations or special construction techniques – such as side hill construction – and for equipment, construction consumables (such as mats) and pipe storage requirements.

FERC will review right-of-way and ATWS requirements during the application review process to ensure that they are adequate for safe construction of the pipeline and that environmental impacts are minimized. Additional factors influencing space requirements are discussed in detail in the sections that follow.

Factors Impacting Permanent and Construction Right-Of-Way Width

The pipeline route is evaluated based on the following project and location-specific factors and typical construction right-of-way widths. Factors considered for typical right-of-way width determination include:

- **Pipeline diameter.** The diameter of the pipeline is the most significant factor of the permanent and construction workspace requirements. The line diameter dictates the types and sizes of equipment required for construction, the construction methods, the size and depth of the ditch and the amount of space required for spoil storage.

- **Depth of Cover. T**he depth of cover of the pipeline determines the depth of the ditch based on pipeline diameter. Depth affects the amount of topsoil and especially subsoil that is excavated and must be stored on the right-of-way.

- **Predominant terrain type.** Terrain will drive workspace requirements in order to ensure safe working conditions during pipeline construction. Terrain examples that may require wider-than-normal construction right-of-way include hilly, mountainous or side-slope conditions. Due to environmental permit conditions, narrower rights of way generally are used during pipeline construction in wetlands to minimize environmental impacts. However, the narrower right of way requires the use of specialized construction techniques and results in less efficient construction. To minimize the negative effect of workspace narrowing, careful planning is necessary, including consideration of additional temporary workspaces on each side of the wetland and additional access roads for longer crossings. The typical effect of conditions such as these on the right-of-way configuration increases as the length of the terrain situation increases.

- **Predominant soil type.** Certain soil types may require a wider trench, and therefore a wider construction right of way. OSHA regulations at 29 CFR 1926 Subpart P, Appendix A, excerpted below[3], addresses soil classification definitions. The regulations describe a method of classifying soil and rock deposits based on site and environmental conditions, and on the structure and composition of the earth deposits. The appendix contains definitions, sets forth requirements, and describes acceptable visual and manual tests for use in classifying soils. Less cohesive soils such as dry, sandy or saturated organic soils (soil Types C) require wider ditches to reach depth, resulting in larger amounts of spoil. Additionally, these soil type spoils require more area for storage (more right-of-way width) since they require wide-slope piles. This increases workspace requirements.

- **Topsoil segregation.** Where topsoil segregation is required, the localized topsoil conditions can require different depths of salvage. Therefore, the average topsoil depth should be included in the workspace requirement evaluation along the route. Full right-of-way width topsoil segregation requires additional space for topsoil storage. The FERC Plan allows 25 extra feet for full right-of-way topsoil segregation.

[3] "**Type A**" means cohesive soils with an unconfined, compressive strength of 1.5 ton per square foot (tsf) (144 kPa) or greater. Examples of cohesive soils are: clay, silty clay, sandy clay, clay loam and, in some cases, silty clay loam and sandy clay loam. Cemented soils such as caliche and hardpan are also considered Type A. However, no soil is Type A if: (i) The soil is fissured; or (ii) The soil is subject to vibration from heavy traffic, pile driving, or similar effects; or (iii) The soil has been previously disturbed; or (iv) The soil is part of a sloped, layered system where the layers dip into the excavation on a slope of four horizontal to one vertical (4H:1V) or greater; or (v) The material is subject to other factors that would require it to be classified as a less stable material.
"**Type B**" means: (i) Cohesive soil with an unconfined compressive strength greater than 0.5 tsf (48 kPa) but less than 1.5 tsf (144 kPa); or (ii) Granular cohesionless soils including: angular gravel (similar to crushed rock), silt, silt loam, sandy loam and, in some cases, silty clay loam and sandy clay loam. (iii) Previously disturbed soils, except those which would otherwise be classed as Type C soil. (iv) Soil that meets the unconfined compressive strength or cementation requirements for Type A, but is fissured or subject to vibration; or (v) Dry rock that is not stable; or (vi) Material that is part of a sloped, layered system where the layers dip into the excavation on a slope less steep than four horizontal to one vertical (4H:1V), but only if the material would otherwise be classified as Type B.
"**Type C**" means:(i) Cohesive soil with an unconfined compressive strength of 0.5 tsf (48 kPa) or less; or (ii) Granular soils including gravel, sand, and loamy sand; or (iii) Submerged soil or soil from which water is freely seeping; or (iv) Submerged rock that is not stable, or (v) Material in a sloped, layered system where the layers dip into the excavation or a slope of four horizontal to one vertical (4H:1V) or steeper. "Unconfined compressive strength" means the load per unit area at which a soil will fail in compression. It can be determined by laboratory testing, or estimated in the field using a pocket penetrometer, by thumb penetration tests, and other methods. "Wet soil" means soil that contains significantly more moisture than moist soil, but in such a range of values that cohesive material will slump or begin to flow when vibrated. Granular material that would exhibit cohesive properties when moist will lose those cohesive properties when wet.

Permanent and Construction Right-Of-Way Requirements

Workspace for long, cross-country pipeline construction projects must be adequate to accommodate excavated soil, which is stored on one side of the pipeline ditch (the "spoil side") and the work conducted on the other side of the ditch (the "working side"). The spoil-side workspace generally is laid out with any topsoil salvaged at the far edge of the spoil side and the sub-soil from the ditch between the topsoil and the ditch. The spoil-side workspace normally includes the permanent right-of-way plus a temporary construction right-of-way. The working side workspace must allow room to string and weld the pipe, accommodate personnel access, move and operate equipment, and to travel (travel lane) along the far side of the right-of-way.

The travel lane generally is located in the temporary right-of-way on the working side. The travel lane, which provides for efficient construction and safety, allows travel along the right-of-way in case of emergency. Topsoil occasionally is stored on the outside edge of the working side of the right-of-way depending on space considerations (on the spoil side) and whether full right-of-way width topsoil segregation is being employed.

These nominal, or "typical," space requirements can be modified for short distances to accommodate site-specific situations, such as wetlands or proximity of permanent structures. However, this often results in building closer to existing pipelines and other infrastructure, or reducing the workspace available, which decreases efficiency and worker safety and also increases difficulty of construction. Modifications typically require the addition of ATWS on either end of the reduced construction right-of-way. Under no circumstances can safety of the workers or neighboring properties be compromised.

Components of Working Side

The working side must contain adequate space to allow for stringing pipe (described in Primer, Section 3.5) adjacent to the ditch where it is to be installed. It may be desirable to string pipe before trenching to minimize the length of time the trench is open. However, certain soil types may require that trenching is done first to enable the trench line to be defined and safe separation of the pipe string from the trench. In the later case, the contractor should minimize the amount of time the trench is open. OSHA regulations require that a setback of two feet be maintained between the pipe and the trench. The pipe joints are strung at a slight angle relative to the ditch for handling purposes during assembly. The welded pipe string and its temporary wooden skid pipe supports typically are ten to twelve feet wide. The workspace must accommodate an excavator or side boom in the working lane, and a travel lane for to allow equipment passing and for emergency vehicle access. FERC requires that construction equipment, as well as materials and spoil, stay within the approved construction right of way and ATWS. This requires separation of equipment and spoil from the edge of workspaces. The required space is summarized below in Table A1.

Table A1 – Working Side Space Requirements

Uplands Construction, Type B Soils, level terrain, 36-inch Depth of Cover and Ditch and Spoil-Side Topsoil Segregation –Refer to Drawing 1 in Appendix B

Component	36 inch	42 inch
Trench Width (1/2 on Working Side)	5	6
OSHA Trench Offset	2	2
Pipe String	10	14
Worker Access	5	5
Excavator/Side Boom (Working Lane)	14-18	18
Worker Access	5	5
Excavator/Side boom (Travel Lane)	14-18	18
Offset From Adjacent Property	2	2
Total	65	70

Components of Spoil Side

The spoil side must contain adequate space to allow for storage of the topsoil and ditch spoil. The space required will depend on:

- Diameter of the pipeline to be installed,
- Depth of cover required,
- Soil type and characteristics (saturated, angle of repose, etc), and
- Whether full right-of-way width topsoil segregation is used in that area.

OSHA regulations require a setback of two feet from the trench edge. FERC expects that equipment and materials be contained on the right of way, and not go onto adjacent properties. This has the practical effect of requiring separation from the edge to ensure containment. A consensus among INGAA Foundation member operators and construction contractors established two feet as a typical value. The required space is summarized below in Table A2.

Tables A3 and A4 provide approximate spoil and topsoil space requirements corresponding to specified diameters and soil types, assuming a depth of cover of 36 inches and 42 inches, respectively. The exact amount of topsoil and spoil will depend on exact composition of soil and soil compaction characteristics. The estimates are provided to show how space requirements have been developed. This enables one to compute the approximate space required when combined with dimensions specified in Tables A1 and A2. Location specific conditions may require further modification of the dimensions.

Table A2 – Spoil Side Space Requirements

Uplands Construction, Type B Soils, 36-inch Depth of Cover and Ditch and Spoil-Side

Topsoil Segregation – Refer to Drawing 1 in Appendix B

	Space	(Feet)
Component	36 inch	42 inch
Trench Width (1/2 on Working Side)	5	6
OSHA Trench Offset	2	2
Spoil Pile	20	23
Subsoil and Topsoil Pile Separation	1	1
Topsoil Pile	5	6
Offset From Adjacent Property	2	2
Total	35	40

Example of Permanent and Construction Right-Of-Way Needs

To give this discussion perspective, consider the case of a 36-inch-diameter pipeline located on generally flat ground, designed with a depth of cover of 36 inches.

Table A3 – Example Space Requirements for 36" Pipeline, 36" Cover

Uplands Construction and Ditch and Spoil-Side Topsoil Segregation

Component	Type A Soil Space (Feet)	Type B Soil Space (Feet)	Type C Soil Space (Feet)
Trench width, bottom	5	5	5
Trench width, surface	8	10	15
Topsoil and Spoil Width	15′	25′	14′
Working side width	65	65	70
Spoil side width	30	35	40
Total construction width	95	100	110

Table A4 – Example Space Requirements for 42″ Pipeline, 36″ Cover

Uplands Construction with Ditch and Spoil-Side Topsoil Segregation

Component	Type A Soil Space (Feet)	Type B Soil Space (Feet)	Type C Soil Space (Feet)
Trench width, bottom	6	6	6
Trench width, surface	10	12	17
Topsoil and Spoil Width	25	29	32
Working side width	70	70	75
Spoil side width	35	40	45
Total construction width	105	110	120

Considerations of Right-of-Way Width for Large Diameter Pipeline

Many projects from 2006 to date have been built with 42-inch diameter pipe. As shown in the table A4 this primer' authors determined that for a 42″ diameter pipeline in type B soils, the optimal right-of-way width was for 110 feet to ensure the safety of workers, equipment, pipeline and landowner property

However, the right-of-way space may be smaller in certain conditions, including areas where population density, other infrastructure is present, or there are sensitive environmental area constraints. Conversely more space will be needed in other circumstances.

Still, when the space is available, 110 feet was determined to be the optimal right of way to ensure adequate workspace to allow the construction process to move at a brisk, but safe pace. Providing a 110 feet right of way (when space is available) from the start of a project would help leads to shorter time of disturbance of the right of way. Restricted space often increases work time, and can lead to unforeseen disturbances.

Moreover, by allowing a 110 feet right of way from the start, pipeline companies, their contractors and FERC could avoid the need to submit and process right-of-way variances to address potentially unsafe conditions. Development and processing of variances takes additional time, resources and attention away from the primary task at hand: safely and efficiently constructing the pipeline.

Many 42-inch-diameter pipeline projects have been constructed on 100 foot wide rights-of-way. In addition, many project proponents have proposed rights of way wider than 100 feet or even 110 feet, which have been approved by the FERC after analysis. The following table identifies a number of major projects installing 42-inch pipeline that have been approved for wider rights-of-way than even 110 feet along with the reasons why the width was approved.

Table A5 - Approved ROW Comparison				
Project Name (Docket Number)	Pipe Diameter	Temporary		Notes
		Proposed	Approved	Explanations for why projects conform to the 110' criteria in the primer
ROW Widths Appearing to Exceed 110'				
Rockies Express West (CP06-354)	42", 24"	125	125	•Extra width granted due to use of Caterpillar 594s and 289s (pipelayers) •Mechanized welding shacks "leap frogged"
Rockies Express East (CP07-208)	42"	125	125	•Larger pipelayers •Mechanized welding •Additional depth/spoil in agricultural areas
Ruby (CP09-54)	42"	115	115	•Alternate MAOP required 4' of cover instead of 3'
Tiger Pipeline (CP09-460)	42"	150	150	•Only 100' in uplands and non-harvested upland forest. •FERC approved 125' in areas where pine was harvested •Depth of cover was 4' instead of 3'. •Where full ROW topsoil segregation was required, 150' was needed
KM Louisiana Pipeline (CP06-449)	42"	155	155	•155' allowed when two lines were parallel to existing ROW •155' allowed when ditch-plus-spoil-side segregation is needed •Otherwise, only 120' including topsoil segregation. • Type C soil conditions
Fayetteville Express Pipeline (CP09-433)	42"	150	150	•125': blasting, dense bedrock, and full ROW topsoil segregation •ROW would be 150' due to full topsoil segregation •4-5 ' of cover for deep tillage tools. •Broader trenches are also required for the silty soils.
Questar's Overthrust (CP10-3)	36"	110	110	•Full ROW width for topsoil segregation •Safety considerations for higher than normal traffic from "dead end" access. •~70% of the project was collocated and overlapped with existing ROW.
Rockies Express Phase 1 , Segment 2 (CP04-413)	42"	125	125	•115' was approved for ditch and spoilside topsoil segregation •125' was approved when full ROW topsoil segregation was used •Sandy, type C soils
ROW Width Requests in Excess of 100' which were Denied				
SESH (CP07-044)	42"	125	100	•FERC denied 125' citing construction techniques did not justify the width •100' ROW width was used for other 42" pipe in the same area
Mid Continent Express (CP08-6)	42"	125	100	•Denied 125' because construction not in "rainy season" •MEP proposal does not have full ROW topsoil segregation.

Even when external circumstances such as agricultural mitigation, side slopes, or DOT requirements do not apply, there is a constant and important need for an adequate right of way to ensure worker and equipment safety when installing a large-diameter pipeline. As one way of testing whether a right of way narrower than 110 feet is adequate for large pipe installation, this primer's authors conducted case reviews of completed projects.

Case-Study: Temporary Right-of-Way Width for 42-Inch Project

As noted, the Primer's 110-foot-wide nominal temporary ROW for 42-inch-diameter pipe for uplands construction assumes Type B soil, with ditch and spoil side topsoil segregation and a standard depth of cover of 36 inches. In 2012, while reviewing completed projects, the primer's steering committee working group identified pipeline companies that had requested more than 100 feet but were limited to 100 feet in their FERC order. These companies were interviewed about their experience with 100-foot ROW width. In addition, the work group reviewed the original filings, environmental analyses and other relevant documents for each of these projects. Every company interviewed responded with the same three concerns about the restricted width:

1. It risks making construction less safe because people and equipment are working closer together
2. It caused more unforeseen off-ROW land disturbances
3. It resulted in numerous ATWS requests, which resulted in delays, increased costs or both.

The interviews helped solidify the author's view that a right-of-way wider than 100 feet was needed for high-diameter pipeline projects.

To explore this in greater depth, the INGAA Foundation examined one multi-hundred mile project, which requested a right of way up to 125 feet, but was only granted 100 feet. The work group reviewed the Weekly Compliance Monitoring Reports, filed with FERC, to gain insight into the effects that the narrower ROW width had on the project. The non-compliance report, problem areas and variance requests were tabulated throughout the construction period.

The project reviewed was cited more than 85 times for non compliance and problem areas (combined) Most of these issues could have been alleviated with additional ROW width. In addition, the company requested more than 30 additional variances for additional ROW width.

The majority of the non-compliance issues and problem areas involved the company's improper segregation of topsoil and subsoil, an issue directly related to ROW constraints because proper segregation of topsoil is challenging when the spoil storage-side is constrained.

Other non-compliance issues included driving construction equipment outside of the certified construction right of way, primarily for safe vehicle passage and placing topsoil outside of the construction right-of-way. Variances were counted if the company requested additional temporary workspace for equipment mobility or spoil storage.

Upon review, it was determined that an ROW width of 110 feet wide would have eliminated in many cases, or at least minimized, these problems and non-compliances.

There will be many projects where the optimal 110-foot right of way will be unavailable because of other infrastructure, residential areas, environmental conditions, topography or other land-use types. Pipeline companies and their contractors should make a good faith effort to work within the constraints. However when space is available, the justification for a wider right-of-way is clear.

Components of Permanent ROW Accounting For Maintenance and Integrity Work

Operators must excavate the area around the pipe periodically during the pipeline's life cycle. Operators frequently need to access the right of way to access the pipeline to implement the Office of Pipeline Safety (OPS) regulatory-driven maintenance and integrity work activities. A simple excavation to examine a relatively short, defined section of the pipeline during integrity management work activity is commonly referred to as a "bell hole."

A simple excavation may be 20-feet long but may extend several hundred feet long depending upon the type of work. Maintenance bell hole excavations, particularly for maintenance and integrity excavations are different than a trench excavated for original construction. Specifically, the construction trench typically is constructed to provide approximately 6-12 inches on each side of the pipe and six inches below the pipe for placing soil padding under the pipe. However, maintenance or integrity excavation requires a minimum of three feet of space for workers in the bell hole on each side of the pipe as well as access under the pipe for non-destructive evaluation and coating assessment-related work.

OSHA 19 CFR 1926.651 defines requirements for trenching where workers enter an excavation, and 19 CFR 1926, Subpart P. Appendix B defines requirements for sloping and benching depending on trench walls when personnel are in the trench. The requirements are dependent on ditch depth and soil type, among other factors. Although trench boxes are sometimes appropriate for shorter distances, they are impractical for longer excavations (beyond several hundred feet).

The Code of Federal Regulations, specifically 49 CFR 192.327, allow pipelines in Location Class 1 areas, which are generally not in close proximity to occupied dwellings, to be buried at 30 inches, however the typical depth of cover for cross country transmission pipelines is 36 inches. Many state damage prevention laws require states to have utility damage prevention regulations requiring a tolerance zone around underground structures where only hand digging is allowed. This means that a mechanical trencher or excavator can be used to remove topsoil and subsoil above or beside the pipe no closer than the 18–24 inches (varies per state) excavation offset tolerance distance.

When conducting maintenance and integrity activities, as in new construction, if topsoil segregation is required, it must be removed first and stored in a pile separate from the excavated subsoil pile. The material in both piles must be stacked with enough slope to ensure that there is not significant erosion of the pile during a heavy rainfall. OSHA regulations require that spoil be stored at least two feet back from the edge of the ditch. Typically, excavators prefer to stack topsoil and spoil immediately adjacent, or parallel, to the pipeline. For smaller, conventional circular bell holes, an excavator can carry topsoil and spoil to an unexcavated area along the pipeline space permitting. However, there may be circumstances when the excavation length will be significantly longer (e.g. a major pipe replacement for class change or recoating project). In this situation, the ability to store topsoil and spoil along unexcavated locations on the pipeline right of way is essentially prohibited, and additional adjacent space is required.

As an example, based on the requirements described above, in type B soils, the bell hole requires approximately 25 feet of surface space for the 36-inch pipe (2.5 feet on each side of the pipe centerline).

In making the excavation for the bell hole and conducting maintenance and integrity work, the operator must be able to have sufficient space to move equipment and materials on the right of way. An excavator for smaller diameter pipeline bell holes is typically 11 feet wide; whereas for large diameter pipelines will vary from 14 to 18 feet in width. While making the excavation can be done with the smaller sized excavator, if a section of pipe needs to be removed the larger excavator may be required. Requirements for set back described above and access for worker safety require approximately an additional ten feet.

Summary of Permanent Right-of-Way Width Requirements

Given the dimensions defined above, the space requirements are approximately 40 feet for diameters less than 24 inches, 50 feet for 24 through 36 inches, 60 feet for 42 inches and 75 feet for 48 inches.

The pipeline route is evaluated based on the project and location-specific factors described above, and typical construction right-of-way widths determined. The typical construction right-of-way configuration and width can vary along a pipeline route due to changing localized conditions of the terrain being crossed such as:

- Wetland or marshes
- Steep slopes
- Confined crossing locations due to other utilities
- Existing structures or terrain

- Side hill construction requiring two-toning the construction right-of-way
- When paralleling (co-locating) with other existing infrastructure
- Full right-of-way width topsoil segregation
- Construction in agricultural areas

There also may be the need for site-specific changes in the construction right-of-way width for construction activity such as:

- Hydrostatic testing
- Installation of valves
- Crossing other utilities
- Timber storage
- Spread breaks, etc.

Each situation is discussed in detail below, and includes widths for multiple pipe diameters.

Co-location of Other Infrastructure

When co-locating a pipeline in proximity to another utility, the construction and permanent right-of-way must be designed to maintain safety during both the initial construction of the pipeline as well as during ongoing operations and maintenance and integrity management-related activity. The type of utility a pipeline is being co-located with determines its right-of-way requirements. When co-locating with a pipeline, the diameter and integrity of the pipeline being paralleled must be considered for safety. As described above, the workspace requirements are diameter dependent, with larger diameter pipelines requiring larger workspaces and equipment, and preferably, larger separation between the new and existing pipelines. An example of a situation where integrity is considered is one in which a pipeline with non-welded, mechanical couplings is adjacent to a new pipeline. This will require more separation to ensure no movement of the existing pipeline.

In the future, federal government requirements likely will increase for integrity management of existing facilities. After careful consideration of industry's experience with parallel construction of new pipelines — and especially maintenance adjacent to, on and over existing lines – this primer's authors determined that the minimum, preferred separation is 50 feet between existing and new lines.

This separation area generally insures that construction equipment working on a pipeline would not have to work over the adjacent existing in-service line and improve pipeline and worker safety. This separation is sized is to allow for safety during construction, and especially, operational maintenance, as well as integrity activities. The primary driver for the right-of-way width and pipeline separation distance recommendations are:

- The difference in diameter between the new pipeline and the existing pipeline

- Industry-wide safety practice to avoid having large equipment working over the existing line
- Depth of burial of the new and existing pipelines

If closer spacing to the existing line is required due to localized conditions, careful consideration must be given to the diameter and integrity of the existing pipeline and the local soil conditions.

If paralleling an electric utility corridor, a pipeline company must consider the voltage of the system being paralleled as it determines the offset. Other considerations should include: the type of structure (poles, foundations, towers. the presence of guy wires and any restrictions on the approach distance due to easement stipulations by the power company.

When paralleling transportation infrastructure such as a road, the offset often will be dictated by the easement agreement, including future expansion plans for highways or major roads. When parallel to railroads, if the pipeline is in the railroad right-of-way, extra depth of cover will be required. This also may be the case when installing pipe parallel to a road or highway in the existing right-of-way. In all cases of co-location, any extra depth requirements and the offset and right-of-way widths should be evaluated to achieve maximum safety during construction and during subsequent operations, maintenance and integrity-related activities.

Considerations Regarding Specific Right-Of-Way Circumstances

The following right-of-way circumstances include a discussion that relates to the right-of-way dimensions and space requirements shown in the drawings in Appendix B.

Greenfield Right-Of-Way – Conventional Manual (Stick) Welding - Drawing 1 is a typical construction right of way for a greenfield (non-co-located) pipeline using conventional welding techniques in relatively flat terrain with soils that are relatively stable (Type “B” soils are assumed), with ditch and spoil-side topsoil segregation. The primary drivers for greenfield right-of-way width recommendations are the line diameter, the equipment required to install the line size and the depth of cover. Section IV.2 the FERC Plan allows the construction right-of-way to be expanded in limited non-wetland areas by up to 25 feet without director approval to accommodate full right-of-way topsoil segregation.

Greenfield Right-Of-Way – Mechanized Welding - Drawing 2 is a typical construction right of way for a greenfield (non-co-located) pipeline using mechanized welding techniques in relatively flat terrain with soils that are relatively stable (Type “B” soils are assumed). The primary drivers for the right -of-way width recommendations are the line diameter, the equipment required to install the line size and the depth of cover. The right-of-way width shown is the same as for conventional manual welding. The Ad-Hoc

Construction Work Group discussed space requirements for mechanized welding and especially transportation of welding shacks along the right of way. There may be circumstances on larger-diameter pipelines (>36 inch) where there will be more space required based on the size of the shacks and the need to allow additional space to move the shacks along the right-of-way. The group agreed that mechanized welding construction can be performed in the same typical workspace. Still larger extra work spaces may be required for equipment staging at start and stop points and other features along the right of way due to the greater space for side boom tractors and equipment required for this construction technique.

Co-Location Adjacent to Existing Right-Of-Way – Conventional Stick Welding - Drawing 3 is a typical construction right of way for co-location with an existing pipeline using conventional welding techniques in relatively flat terrain with soils that are relatively stable (Type "B" soils are assumed). The preferred and minimum recommended separation of 50 feet separation between existing and new lines 30 inches in diameter and larger assumes the existing pipeline has welded construction. This separation is sized is to allow for safety during both construction and especially operational maintenance activity. Even for smaller diameter pipelines the wider separation can be preferable for maintenance and pipeline integrity work as well as for future capacity expansion, where space is available.

As stated above, the primary driver for the right-of-way width recommendations is the new pipeline diameter and depth of cover. A portion of the existing right of way can be utilized if an agreement can be reached between the existing pipeline operator and the owner of the pipeline being constructed, depending upon local site conditions, the condition and operating history of the existing pipeline and its location in the existing right of way. If closer spacing to the existing pipeline is required due to localized conditions, careful consideration must be given to the diameter and integrity of the existing pipeline, as well as local soil conditions. In cases where the new pipeline is a larger diameter than the existing pipeline, the bottom of the new ditch will be deeper than the existing pipeline. In cases of unstable soil conditions, this could cause undercutting of the existing line. If that should happen, the existing pipeline could shift toward the adjacent ditch. Special construction techniques such a sheet pile or shoring could be required (in some cases) to maintain the integrity of the existing pipeline.

Co-Location Adjacent to Existing Right-Of-Way – Mechanized Welding - Drawing 4 is a typical construction right of way for co-location with an existing pipeline using mechanized welding techniques in relatively flat terrain with soils that are relatively stable (Type "B" soils are assumed). The recommended separation of up to 50 feet allows for safety during both construction and operational maintenance activity.

The primary driver for the right-of-way width recommendations is the diameter of the new pipeline. A portion of the existing right of way can be utilized if an agreement can be reached between the existing pipeline operator and the owner of the pipeline being constructed, depending upon local site conditions, the condition and operating history of the existing pipeline and its location in the existing right of way. If closer spacing is required due to localized conditions, careful consideration must be given to the diameter and integrity of the existing pipeline, as well as the local soil conditions. If the new pipeline is a larger diameter than the existing pipeline, the bottom of the new ditch will be deeper than the existing pipeline. In situations where the soil conditions are unstable, the existing line could be undercut, causing it to shift towards the adjacent ditch. Special construction techniques such a sheet pile or shoring may be required (in some cases) to maintain the integrity of the existing pipeline.

Co-Location Adjacent to Existing Power Line Right-Of-Way - Drawing 5 is a typical construction right of way for co-location along a 500 KV electrical corridor with stable soil conditions. The recommended offset from the power line is determined by the OSHA minimum approach radius plus a safety factor totaling 50 feet. The offset is to ensure that there is not direct contact with the power system as well as indirect, which can result in arcing and electric flow. This is to ensure that movement of equipment and people operating the equipment are at a safe distance. Additionally the type of tower must be evaluated. If the tower has guy wires, there are typical restrictions regarding approach and excavation distance offsets that must be observed. Drawing 5 depicts a "halo." The contractor must account for boom lengths and well as guy wires from electrical transmission structures. The offset also helps to manage AC interference, which can occur and result in metal loss if unchecked. Operators will develop mitigation plans when near high voltage power lines.

Note that the topsoil storage has been moved to the working side to maintain the recommended offset of equipment working in proximity to the electric lines and towers in the utility corridor.

Greenfield Right-Of-Way – Non-saturated Wetland - Drawing 6 is a typical construction right of way for a greenfield (non-co-located) pipeline in a non-saturated wetland with moderately stable soils. The primary drivers for the right-of-way width recommendations are the increased area required for the soil storage of moderately non-cohesive soils, topsoil segregation and the pipeline diameter. There is no travel lane in this configuration. As a result, there is an increased need for access roads to the right of way if long stretches of this type of construction are encountered, as well as extra workspace on each end of the wetland for storage of material such as construction mats, concrete coated pipe, concrete set-on weights, equipment staging, and for refueling equipment at the required setback distance from the wetland.

Greenfield Right-Of-Way – Saturated Wetland - Drawing 7 is a typical construction right of way for a greenfield (non-co-located) pipeline in a saturated wetland with unstable, non-cohesive soils. The primary drivers for the right-of-way width recommendations are the increased area required for the soil storage of the non-cohesive soils and the pipeline diameter. There is not a travel lane in this configuration.

As a result, there is an increased need for access roads to the right-of-way if long stretches of this type of construction are encountered, as well as extra workspace on each end of the wetland for material mats, concrete coated pipe, concrete set-on weights, equipment staging, and for refueling equipment at the required setback distance from the wetland.

Greenfield Right-Of-Way – Submerged Wetland - Drawing 8 is a typical construction right of way for a greenfield (non-co-located) pipeline in a submerged wetland with very unstable, non-cohesive soils. The primary drivers for the right-of-way width recommendations are the increased area required for the soil storage of the non-cohesive soils, and the pipeline diameter. For this specialized construction technique, the ditch is excavated using amphibious tracked equipment or a tracked excavator working off of timber construction mats that are moved along the right of way by the excavation equipment in a leapfrog fashion. After the ditch is dug, the pipe is installed using the push construction technique.

For this construction method, equipment access through the wetland typically is available only at the beginning and end of the wetland. Additional temporary workspace (ATWS) is required on each end of the wetland for material set up, the push section, mats, concrete coated pipe, equipment staging and refueling of equipment.

Greenfield Right-Of-Way – Side Hill Construction - Drawing 9 is a typical construction right of way for a greenfield (non-co-located) pipeline on a side-hill slope. The hill must be excavated to create what is known as a bench cut to allow a flat area for the equipment to operate safely during the construction. After construction is completed, the hillside will be restored to the original contour and stabilized.

The primary drivers for the workspace size requirement are the soil stability, the slope angle and the resulting depth of cut required for the bench cut, and the space required for the spoil storage during construction. Note that the pipeline is installed on the downhill side of the bench cut, minimizing the depth of the bench cut and avoiding excessive cover on the installed pipeline. Additionally, the angle of the slope of the bench cut wall must be in accordance with OSHA standards for the soil type for safety reasons. There is not a travel lane in this configuration. As a result, there is an increased need for access roads accessing to the right-of-way if long stretches of this type of construction are required, as well as extra workspace on each end of the sloped section for material storage and equipment staging.

Greenfield Right-Of-Way – Side Hill Two-Toned Construction - Drawing 10 is a typical construction right of way for a greenfield (non-co-located) pipeline on a side hill using a double bench cut, or “two tone” right-of-way. The hill has a wider bench cut to allow a flat area for the equipment to operate safely, as well as a narrow travel lane during the construction. A second bench is cut for the pipe assembly. This construction only can be used in very stable soil conditions due to the proximity of the pipe assembly cut to the ditch and the back slope of the cut. Following construction the hillside will be restored to the original contour and stabilized.

The primary drivers for the workspace size requirements include the soil stability, the slope angle and the resulting depth of cut required for the bench cut and the space required for the spoil storage. The pipeline is installed on the downhill side, minimizing the depth of the bench cut and avoiding excessive cover on the installed pipeline. There is a travel lane in this configuration, due to an increased need for roads accessing the right-of-way locations where long stretches of this type of construction are encountered, as well as extra workspace on each end of the side slope construction areas. Extra workspace is required on each end of the sloped area for material storage and equipment staging.

Greenfield Right-Of-Way –Extra Depth - Drawing 11 is a typical construction right of way for a greenfield (non-co-located) pipeline where additional depth is provided using conventional welding techniques in relatively flat terrain with soils that are relatively stable (Type "B" soils are assumed). Extra depth may be provided in agricultural areas where deep tilling may occur or other reasons based on land use. The primary drivers for the right-of-way width recommendations are the line diameter, the equipment required to install the line size and the extra depth of cover.

As stated in the discussion with Drawing 1, in limited non-wetland areas FERC allows an increase up to 25 additional feet for full right-of-way topside segregation without approval by the director of the Office of Energy Policy. Otherwise, it is expected that a proposal for full right-of-way topsoil segregation will be proposed in the FERC application.

Additional Temporary Work Space Requirements

Requirements for additional temporary workspace are provided in this section. Drawings are also presented for additional temporary workspace (ATWS) for a variety of localized construction features. The contractor should assess the need to construct silt fencing on the right of way and at the edge of additional temporary work spaces.

Road Crossings

Drawing 12 shows a typical open cut road crossing for a greenfield pipeline. The factors that drive the ATWS are:

- **L1[4], W1**– This space is used predominately for spoil storage due to the extra depth ditch at the crossing. Typically the length on each side of the road is equal to the

[4] L is the length and W is the width of the ATWS. Where there are multiple parts to an ATWS and lengths, widths or both differ among the parts, L or W1 and L or

length [width] of the road crossing. The width of the right-of-way is dependent on the depth of the pipe to be installed and the soil type. The width of the right-of-way may have to be extended if unusual depth is required due to road ditches or other existing utilities.

- **L2, W2** – This space is used as a lane to drive the equipment off and on the pipe string area and to cross the road and allow space for assembling the road crossing pipe prior to installation. Typically the length is equal to the width of the road crossing. The right-of-way width is dependent on the type and size of equipment being used.
    - Both sides of the crossing must allow for transition bends and tie-in bell holes.

Drawing 13 shows a typical open cut road crossing for a co-located pipeline. The factors that drive the ATWS are:

- **L, W** – This space is used for both spoil storage due to the extra depth ditch at the crossing and as a lane to drive the equipment on and off the pipe string area and to cross the road and allow space for assembling the road crossing pipe prior to installation. Typically the length on each side of the road is equal to the width of the road crossing, but may need to be increased for larger diameter installations. The width is dependent on the depth of the pipe to be installed and the soil type and is typically wider than when space is available on both the spoil and working sides of the pipeline. Both sides must allow for transition bends and tie-in bell holes. The width may have to be extended if unusual depth is required due to road ditches or other existing utilities.

Drawing 14 shows a typical bored installation road crossing for a greenfield pipeline. The factors that drive the ATWS are:

- **L, W1** – This space is used predominately for spoil storage due to the extra depth ditch at the crossing. For a bored crossing, the ditch must be at full depth for a length at least the full length of the crossing on one side for insertion of the carrier pipe and both sides of the road must allow for transition bends and tie-in bell holes.

  Typically the length is equal to the length [width] of the right of way being crossed and is allowed for on both sides of the crossing during planning to allow the contractor flexibility in installation. The width is dependent on the diameter of the pipe to be installed, the depth of the installation, the soil type and the type and size of the equipment being used. The width may have to be extended if unusually deep depth is required due to road ditches or other existing utilities.

W2 is used. For example, if the ATWS is comprised of two parts and the lengths of both are the same but the widths differ, the dimensions are shown as L1, W1 and L1, W2.

- **L, W2** – This space is used as a lane to drive equipment on and off the pipe string area and to cross the road and allow space for assembling the road crossing pipe prior to installation. For a bored crossing, the ditch must be at full depth for a length at least the length of the right-of-way crossing on one side for insertion of the carrier pipe. Typically the length is equal to the width of the right of way being crossed and is allowed for on both sides of the crossing during planning to allow the contractor flexibility during installation. The width is dependent on the same diameter of the pipe to be installed, the depth of the installation, the soil type and the type and size of the equipment being used.

Drawing 15 shows a typical bored installation road crossing for a co-located pipeline. The factors that drive the ATWS are:

- **L, W** – This space is used for both spoil storage due to the extra depth ditch at the crossing and as a lane to drive equipment on and off the pipe string area and to cross the road and allow space for assembling the road crossing pipe prior to installation. For a bored crossing the ditch must be full depth for a length at least the length of the full crossing on one side for insertion of the carrier pipe. Typically, the length is equal to one and a half times the length of the crossing [width of the right of way], and is allowed for on both sides of the crossing during planning to allow the contractor flexibility in installation. The right-of-way width is dependent on the type and size of equipment being used.

  The right-of-way width also is dependent on the diameter and depth of the pipe to be installed and the soil type and is typically wider than when space is available on both the spoil and working sides of the pipeline. Both sides must allow for transition bends and tie-in bell holes. The width may have to be extended if unusual depth is required due to road ditches or other existing utilities.

Drawing 16 shows a typical open-cut road crossing at an angle of 30 degrees. Drawing 17 shows a typical open-cut road crossing at an angle of 30 degrees for a co-located pipeline. When crossings are angled it necessary to extend the workspaces to maintain symmetry, otherwise one side becomes too short to effectively utilize each side of the crossing. The length of the long side (L2) is the driver and is set by the crossing angle so that the length includes the full width of the road relative to the point of crossing using the same parameters as the normal open cut road crossing. The short (L1) is squared up with L2, with the actual length dependent on the crossing angle.

Bored Crossings

Drawing 18 shows a typical bored installation road crossing at an angle of 30 degrees. Drawing 19 shows a typical bored installation road crossing parallel to an existing pipeline at an angle of 30 degrees. The critical length is L2. The length of the long side (L2) is the driver and is set by the crossing angle so that the length includes the full length of the road crossing relative to the point of crossing using the same parameters as the normal bored road crossing. The short (L1) is squared up with L2, with the actual length dependent on the crossing angle.

Drawing 20 shows a typical bored installation of a greenfield pipeline beneath a railroad crossing. The factors that drive the ATWS are:

- **L, W1** – This space is used predominately for spoil storage due to the extra depth ditch at crossing. For a bored crossing the ditch must be at full depth for at least a length of the full crossing on one side for insertion of the carrier pipe and both sides of the road must allow for transition bends and tie-in bell holes.

  Typically, the length is equal to the length of the right of way being crossed and is allowed for on both sides of the crossing during planning to allow the contractor flexibility in installation. The width is dependent on the diameter and depth of the pipe to be installed and the soil type. The width may have to be extended if unusually deep depth is required due to road ditches or other existing utilities.

- **L, W2** – This space is used as a lane to drive equipment on and off the pipe string area and turn around since the railroad cannot typically be crossed by the construction equipment and allow space for assembling the railroad crossing pipe prior to installation. For a bored crossing the ditch must full depth at for a length least the full right-of-way width on one side for insertion of the carrier pipe. Typically the length is equal to the length [width] of the right-of-way crossing and is allowed for on both sides of the crossing during planning to allow the contractor flexibility in installation. The width is dependent on the type and size of equipment being used.

Drawing 21 shows a typical bored installation railroad crossing for a co-located pipeline. The factors that drive the ATWS are:

- **L, W** – This space is used for both spoil storage due to the extra depth ditch at crossing and as a lane to drive equipment on and off the pipe string and turn around since the railroad cannot typically be crossed by the construction equipment and allow space for assembling the railroad crossing pipe prior to installation. For a bored crossing the ditch must be at full depth at least the full length of the crossing on one side for insertion of the carrier pipe.

  Typically, the length is equal to one and a half times the length of the right of way being crossed, and is needed on both sides of the crossing during planning to allow the contractor flexibility in installation. The width is dependent on the type and size of equipment being used. The width is dependent on the depth of the pipe to be installed and the soil type and is typically wider than when space is available on both the spoil and working sides of the pipeline. Both sides must allow for transition bends and tie-in bell holes. The width may have to be extended if additional depth is required due to road ditches or other existing utilities.

Water Crossings

Drawing 22 shows a typical open cut installation of a water-body crossing of a greenfield pipeline. The factors that drive the ATWS are:

- **L1, W1** – This space is used as a lane to drive equipment on and off the pipe string area as well as to assemble and stage the pre-fabricated pipe for the crossing, set-on weights etc. Typically the length is equal to at least the width of the water-body crossing (high bank to high bank) or the minimum determined to complete the equipment access and is needed on both sides of the crossing. The right-of-way width is dependent on the type and size of equipment being used.

- **L2, W2** – This space is used predominately for spoil storage due to the extra depth ditch at crossing. Typically the length is equal to the length [width] of the water-body crossing (high bank to high bank) and is needed on both sides of the crossing. The right-of-way width is dependent on the diameter and depth of the pipe to be installed and the soil type. The width may have to be extended if unusually large cuts are needed due to high stream banks relative to the watercourse.

Drawings 23 and 24 show typical dam and pump and flume installation, respectively, for an open cut water-body crossing of a greenfield pipeline. The factors that define the ATWS are:

- **L1, W1** – This space is used as a lane to drive equipment on and off the pipe string area as well as to assemble and stage the pre-fabricated pipe for the crossing, set-on weights etc. Typically, the length is equal to at least the width of the water-body crossed (high bank to high bank) or the minimum determined to complete the equipment access and is needed on both sides of the crossing. The width is dependent on the type and size of equipment being used.

- **L2, W2** – This space is used predominately for spoil storage due to the extra depth ditch at crossing. Typically, the length is equal to at least the width of the water-body crossing (high bank to high bank) and is needed on both sides of the crossing. The width is dependent on the diameter and depth of the pipe to be installed and the soil type. The width may have to be extended if unusually large cuts are needed due to high stream banks relative to the watercourse.

Crossings of Other Infrastructure

Drawing 25 shows a typical crossing of an existing pipeline (or other buried structure) of a greenfield pipeline. The extra workspace is used for spoil storage due to extra depth ditch at the crossing. The most desirable crossing angle is between 45 and 90 degrees. If the crossing angle is at or near 90 degrees the workspaces are symmetric on each side and L1 equals L2. If the crossing angle is greater than 45 degrees relative to the existing line, consideration should be given to increasing the oblique angle side of the crossing (L2) such that the length of the L2, starting at a point perpendicular to the pipeline crossing point is equal to the acute angle side length (L1).

The length of L2 is extended to be continuous with L1 to keep the workspace usable relative to the ditch location. The length of the workspace L1 is driven by the length of extra depth ditch needed to transition to the crossing depth. The depth of the ditch required for the crossing and the soil type determines the widths of the workspaces.

Drawing 26 shows a typical crossing of a power line right-of-way by a greenfield pipeline. The length and width of the workspaces are driven by the need to drive equipment on and off the pipeline right of way on each side of the crossing as well as for bell holes for the tie-in on each side of the crossing.

Drawing 27 shows a typical crossing of an existing pipeline (or other large buried utility) by a greenfield pipeline. The length and width of the workspaces are driven by the need to drive equipment on and off the pipeline right-of-way on each side of the crossing for storage of spoil due to the extra depth ditch required to go under existing utility, as well as for bell holes for tie-in on each side of the crossing. The length of the workspace (L1) is dependent on the length needed to transition the pipeline to the required depth and the type of equipment used for the construction. The width is dependent the amount of spoil storage required which is driven by the ditch depth and soil type.

Construction of Mainline Valves

Drawing 28 shows a typical mainline valve installation. The workspace is used to allow storing the assembled mainline valves and heavy wall pipe prior to installation as well as to allow bell holes for tie-in work. The length of the workspace should be equal to the total length of the mainline valve setting, including the required heavy wall pipe plus 25 feet on each side. The width (typically is 25 to 50 feet) is dependent on the diameter of the pipeline.

Spread Break and Turnaround Work Space

Drawing 29 shows a typical workspace for a spread break or turnaround (such as at a river or highway that could not be crossed by the spread, or at the beginning and end of the spread. The length and width are dependent on the type of equipment being used to construct the pipeline. Typically the length is 100-150 feet with a width of 25 feet for pipelines less than 24 inches in diameter, 150-200 feet by 25 feet for 24-30-inch diameter lines, and 250 feet by 50 feet for 36-inch diameter and up.

Temporary Access Road and Road Access

Drawing 30 shows a typical temporary access road and public road access. The width of the access to the public road, the width and length of entry apron as well as the diameter of the temporary culvert are often included in the road access permit acquired. Typically the temporary access road right-of-way is 20-25 feet wide. A temporary culvert may be installed if required.

Hydrostatic Testing Header Workspace

Drawing 31 shows a typical workspace for hydro testing. To hydro test the different sections of the pipeline, the ends of the test sections are typically overlapped several feet, and the test headers are welded onto each test section, resulting in a temporary short section of overlapped pipe about 50-75 feet long for a large diameter pipeline. The ditch must be made extra wide to allow the overlap, and must be dug with sloped sides – as required for the soil type – to allow personnel in the ditch during fill and dewater of the pipelines.

Additionally, there will be equipment such as a test trailer, portable water tanks, fill pumps and pressurization pumps at the location. For a large diameter pipeline a typical workspace would be 150 feet by 50 feet to allow for safe working conditions during the testing of the pipeline.

Mainline valve assemblies are normally hydrostatically tested as an assembly on their own and are not hydrostatically tested within a pipeline hydrostatic test section.

Fitting and Induction-Bend Installation

Drawing 32 shows typical workspace for installation of induction bends used for direction (not elevation) changes. The workspace is needed for the storage of extra spoil from the bell holes needed to make the tie-in weld on each end of the bend. Typically the length (L1, L2, L3 and L4) of the workspace extends 15 to 20 feet past the end of the bend. The width (W) is dependent on the pipe diameter and depth at the bend location.

Wetlands Crossings

Drawing 33 shows typical workspaces at the entry and exit of a wetland crossing. This type of workspace is needed for longer wetlands, typically over 100 feet. The workspaces are used to stockpile mats and set-on weights. The length and width of the workspaces are dependent on the length of the wetland crossed. Construction right-of-way across the wetlands is limited to 75 feet. ATWS should be maintained 50 feet from a wetland.

Drawing 34 shows a typical workspace for the installation of pipe in areas of extensive wetlands where it is not practical to access upland. In this instance a “push” construction technique. In this type of construction, the pipe is welded up one joint at a time and moved in the direction of construction as it is welded. Push sites will be built with timber mats and bored road crossings to allow for a dry and stable work area. There will be multiple welding stations spaced for welding 40-foot nominal length pipe joints, and a non-destructive testing (NDT) radiographic inspection area spaced similarly. After the weld is completed and inspected it is cleaned and coated, floats are attached to the pipe so it can be pushed and floated into the ditch.

The length of the workspace is typically long enough to parallel the welding, NDT, coating and float installation area, plus room for pipe staging and stockpiling. The width is typically 100 - 300 feet, depending on the pipe diameter and length of the push section. Most of the extra workspace will be used for pipe. The length of the push section governs float stockpile, therefore the size of the additional workspace, which is typically 200 - 400 feet long.

Horizontal Directional Drilling

Drawings 35, 36, and 37 show a typical layout for horizontal directional drilling. Drawing 35 shows an overview of the typical right of way for an HDD. Drawing 36 provides a typical layout for the entry portion of the operation and drawing 37 shows the exit.. Workspace for an HDD may require clearing and grading, depending on the entry and exit sites selected for the drill. Since the drill entry location or entry side accommodates the drill rig and supporting equipment, the entry side location requires satisfactory access as well as stable ground conditions to support heavy equipment. Work space requirements on the entry side of a HDD are driven by equipment including:

- the rig unit;
- power unit and generators;
- drill pipe rack and drill pipe;
- water pump;
- drill mud supply;
- drill mud mixing tank;
- drill mud pump; and
- mud handling and cleaning system.

Since the drill exit side is the location for the fabrication of the pipe string as well as where the pipe string is inserted into the bore hole, the workspace required is typically longer to accommodate the pipe string and may require extra temporary workspace outside of the right-of-way known as "false right-of-way". Equipment typically found on the exit or pipe side of the HDD includes:

- exit mud containment tanks/pits;

- cuttings settlement tanks/pits;
- pipe racks and product pipe;
- rollers and pipeline handling equipment;
- side booms and other heavy equipment; and
- pipelines, welding, coating and testing equipment.

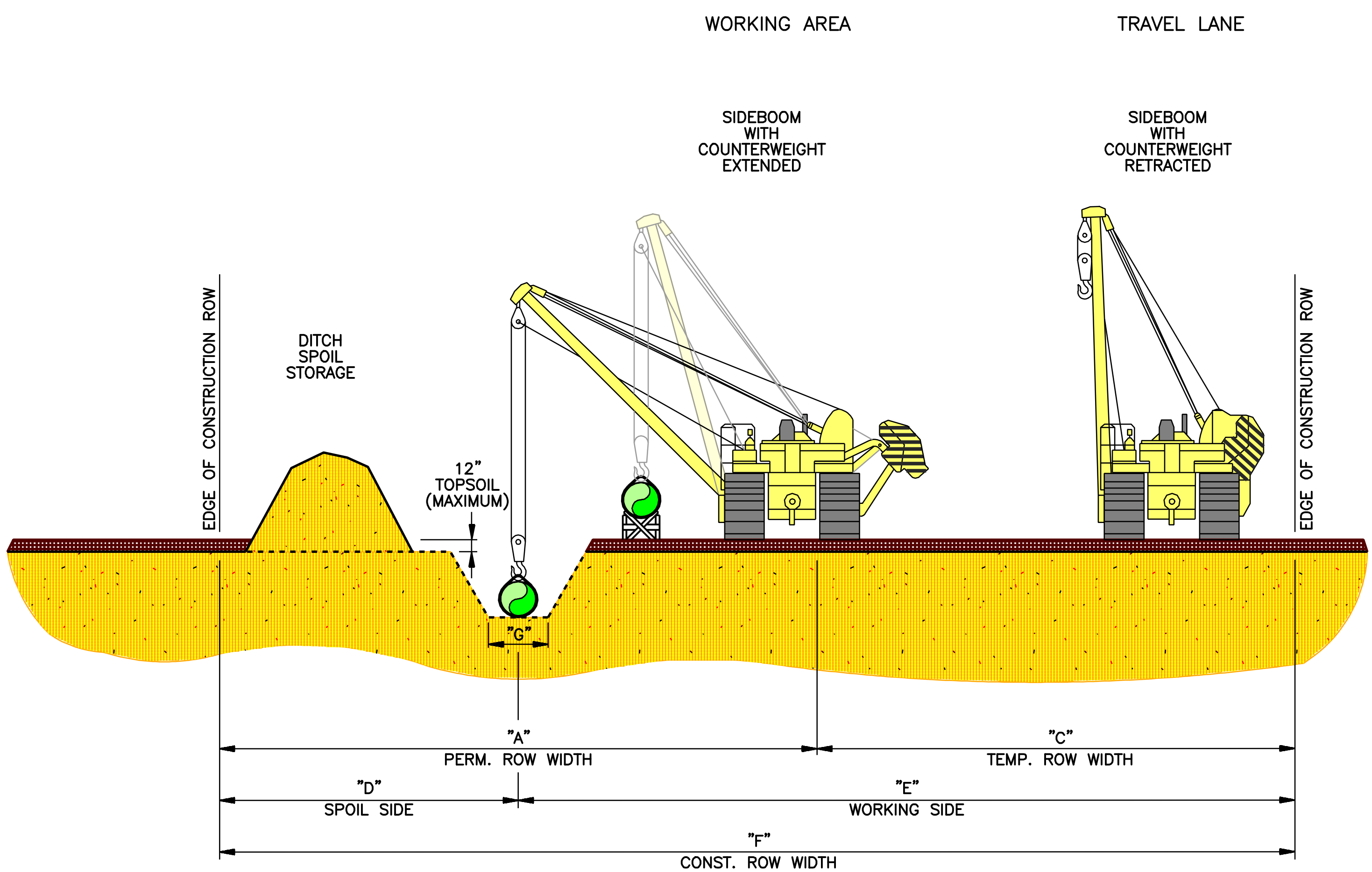
Drawing 38 shows a large rig HDD configuration and the space requirements for this configuration.

Appendix B

Standard Construction Drawings

Appendix C

Guidelines for Parallel Construction of Pipelines



DRAWING ASSUMES TYPE "B" SOIL

R.O.W. DIMENSIONS (FEET EXCEPT FOR DIAMETER, WHICH IS INCHES)						
DIAMETER PIPE	A	C	D	E	F	G
12"	40	35	20	55	75	3
16"	40	40	20	60	80	3
24"	50	40	25	65	90	4
30"	50	40	25	65	90	5
36"	50	40	25	65	90	5
42"	60	40	30	70	100	6
48"	75	35	37.5	72.5	110	6

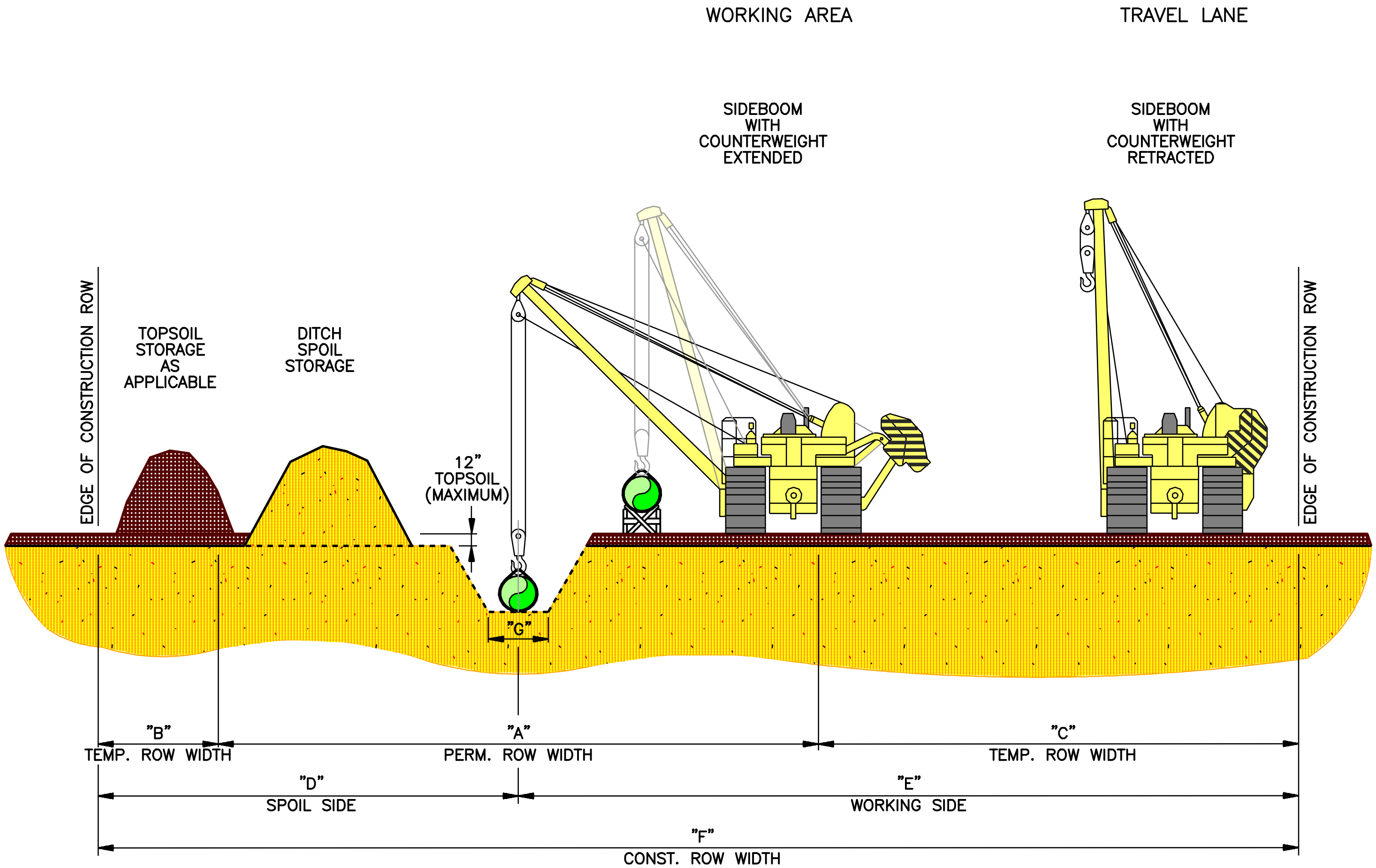
NO.	REVISION	DATE	APPR.

The INGAA Foundation

MAINLINE CONSTRUCTION
NON-PARALLEL CONSTRUCTION
NO TOP SOIL SEGREGATION
RIGHT-OF-WAY

WILLBROS ENGINEERING/EPC
2087 E. 71st Street – Tulsa, OK 74136
(918) 496–0400

DRAWING NUMBER	SHEET
STD-INGAA-1	1 OF 1



DRAWING ASSUMES TYPE "B" SOIL

R.O.W. DIMENSIONS (FEET EXCEPT FOR DIAMETER, WHICH IS INCHES)							
DIAMETER PIPE	A	B	C	D	E	F	G
12"	40	5	30	25	50	75	3
16"	40	10	40	30	60	90	3
24"	50	10	40	35	65	100	4
30"	50	10	40	35	65	100	5
36"	50	10	40	35	65	100	5
42"	60	10	40	40	70	110	6
48"	75	10	35	47.5	72.5	120	6

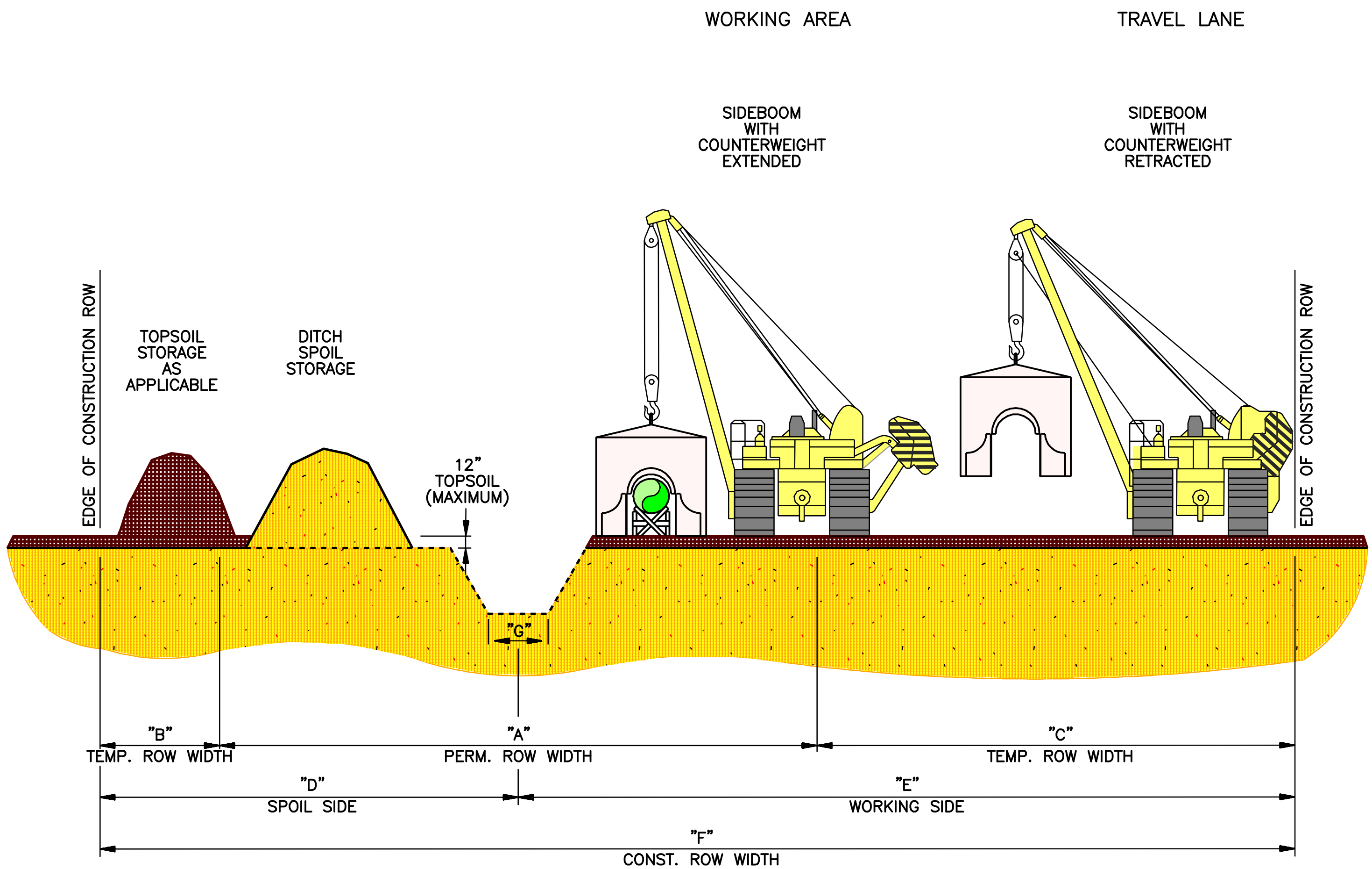
NO.	REVISION	DATE	APPR.

The INGAA Foundation

MAINLINE CONSTRUCTION NON-PARALLEL CONSTRUCTION WITH TOP SOIL SEGREGATION RIGHT-OF-WAY

WILLBROS ENGINEERING/EPC
2087 E. 71st Street – Tulsa, OK 74136
(918) 496–0400

DRAWING NUMBER	SHEET
STD-INGAA-1A	1 OF 1



GENERAL NOTES:

1.) PIPELINE COMPANY AND CONTRACTOR MAY REQUEST ADDITIONAL WORKSPACE FOR MECHANIZED WELDING DEPENDING ON EQUIPMENT AND SITE SPECIFIC CONDITIONS.

R.O.W. DIMENSIONS (FEET EXCEPT FOR DIAMETER, WHICH IS INCHES)

DIAMETER PIPE	A	B	C	D	E	F	G
30"	50	10	40	35	65	100	5
36"	50	10	40	35	65	100	5
42"	60	10	40	40	70	110	6
48"	75	10	35	47.5	72.5	120	6

DRAWING ASSUMES TYPE "B" SOIL

NO.	REVISION	DATE	APPR.

WILLBROS ENGINEERING/EPC
2087 E. 71st Street – Tulsa, OK 74136
(918) 496-0400

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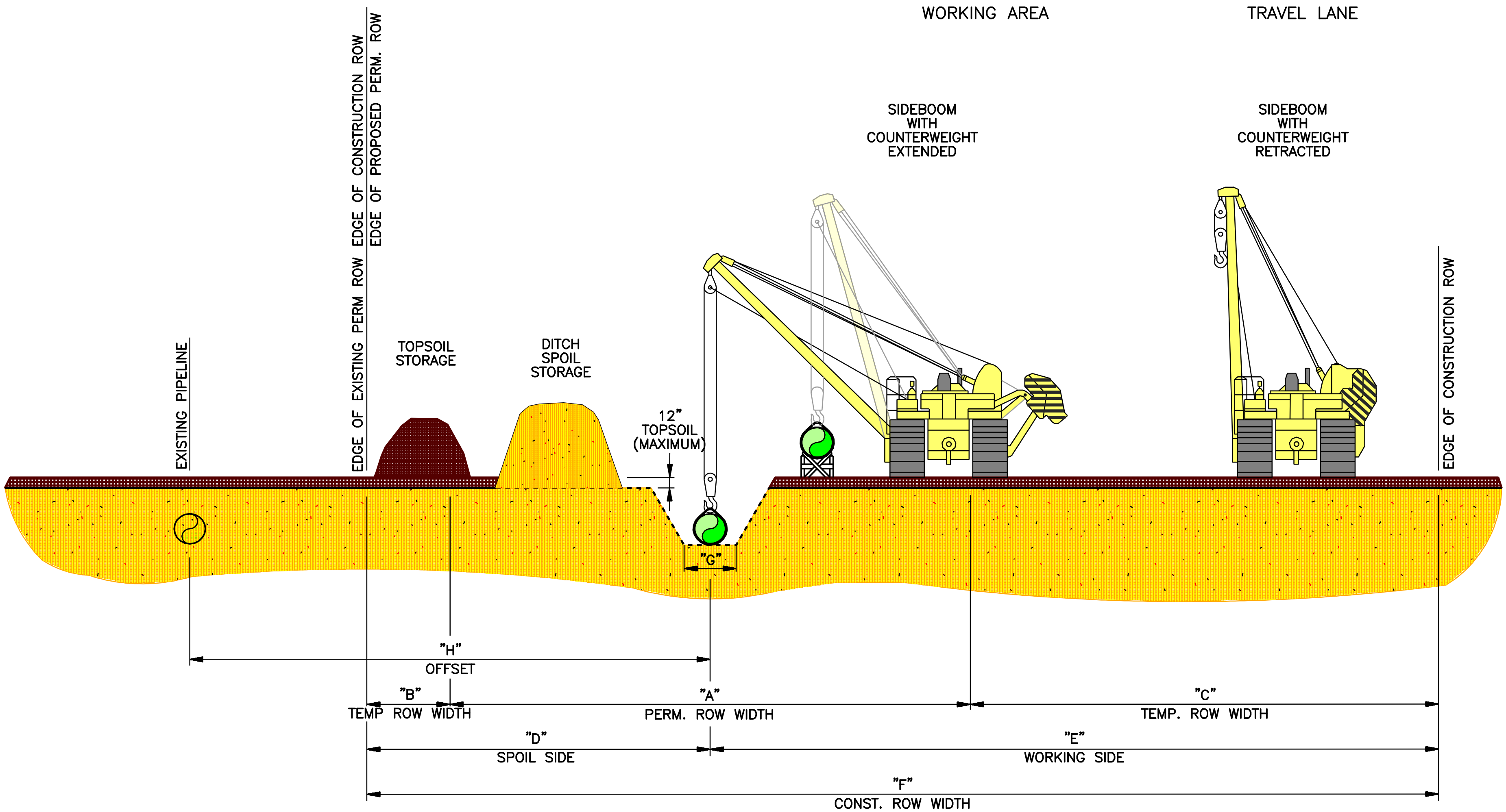
MAINLINE CONSTRUCTION WITH MECHANIZED WELD NON-PARALLEL CONSTRUCTION RIGHT-OF-WAY

DRAWING NUMBER	SHEET
STD-INGAA-2	1 OF 1



GENERAL NOTES:

1.) PREFERRED OFFSET "H" IS 50 FEET, BUT MAY VARY BASED ON SITE SPECIFIC CONDITIONS. SEE TEXT OF PRIMER APPENDIX A.

R.O.W. DIMENSIONS (FEET EXCEPT FOR DIAMETER, WHICH IS INCHES)

DIAMETER PIPE	A	B	C	D	E	F	G	H
12"	40	5	30	25	50	75	3	50
16"	40	10	40	30	60	90	3	50
24"	50	10	40	35	65	100	4	50
30"	50	10	40	35	65	100	5	50
36"	50	10	40	35	65	100	5	50
42"	60	10	40	40	70	110	6	50
48"	75	10	35	47.5	72.5	120	6	50

DRAWING ASSUMES TYPE "B" SOIL

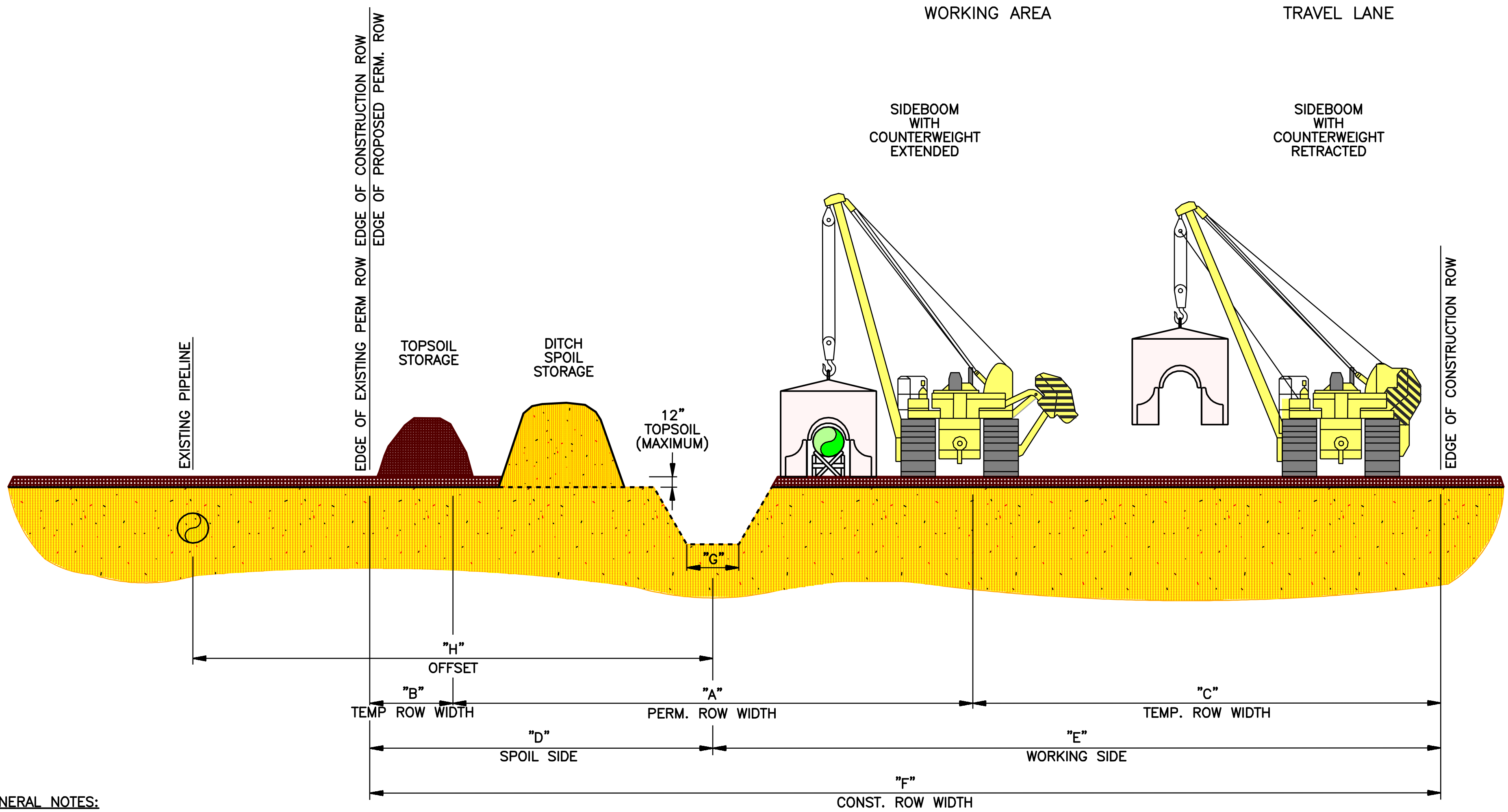
NO.	REVISION	DATE	APPR.

WILLBROS ENGINEERING/EPC
2087 E. 71st Street – Tulsa, OK 74136
(918) 496–0400

The INGAA Foundation

MAINLINE CONSTRUCTION
PARALLEL CONSTRUCTION
RIGHT-OF-WAY

DRAWING NUMBER	SHEET
STD-INGAA-3	1 OF 1



GENERAL NOTES:

1.) PREFERRED OFFSET "H" IS 50 FEET, BUT MAY VARY BASED ON SITE SPECIFIC CONDITIONS. SEE TEXT OF PRIMER APPENDIX A.

2.) PIPELINE COMPANY AND CONTRACTOR MAY REQUEST ADDITIONAL WORKSPACE FOR MECHANIZED WELDING DEPENDING ON EQUIPMENT AND SITE SPECIFIC CONDITIONS.

R.O.W. DIMENSIONS (FEET EXCEPT FOR DIAMETER, WHICH IS INCHES)

DIAMETER PIPE	A	B	C	D	E	F	G	H
30"	50	10	40	35	65	100	5	50
36"	50	10	40	35	65	100	5	50
42"	60	10	40	40	70	110	6	50
48"	75	10	35	47.5	72.5	120	6	50

DRAWING ASSUMES TYPE "B" SOIL

NO.	REVISION	DATE	APPR.

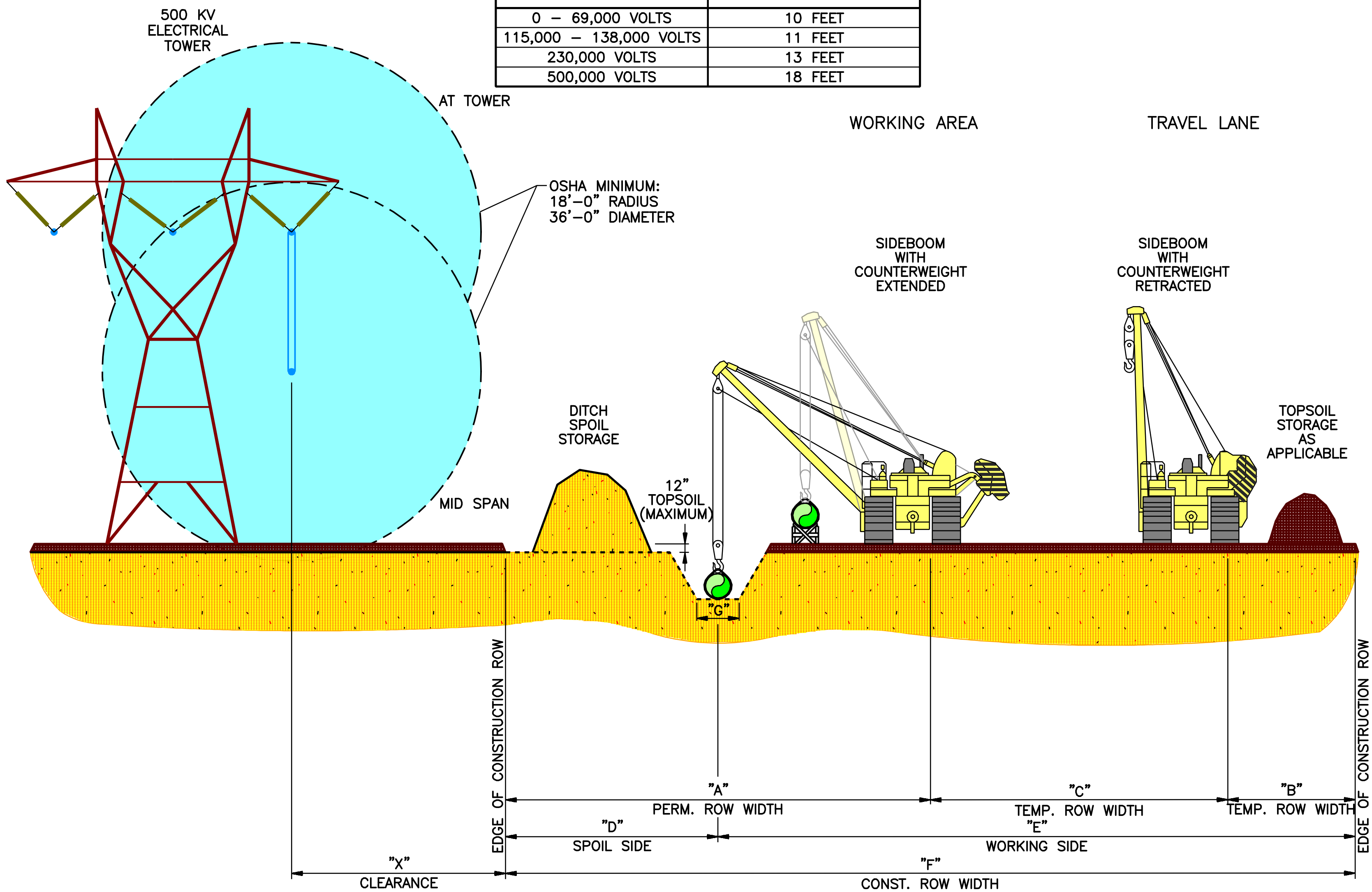
The INGAA Foundation

MAINLINE CONSTRUCTION WITH MECHANIZED WELDING PARALLEL CONSTRUCTION WITH RIGHT-OF-WAY

WILLBROS ENGINEERING/EPC
2087 E. 71st Street – Tulsa, OK 74136
(918) 496–0400

DRAWING NUMBER	SHEET
STD-INGAA-4	1 OF 1

POWER LINE VOLTAGE	OSHA MINIMUM APPROACH DISTANCE
0 – 69,000 VOLTS	10 FEET
115,000 – 138,000 VOLTS	11 FEET
230,000 VOLTS	13 FEET
500,000 VOLTS	18 FEET



R.O.W. DIMENSIONS (FEET EXCEPT FOR DIAMETER, WHICH IS INCHES)

DIAMETER PIPE	A	B	C	D	E	F	G	X
12"	40	5	30	20	55	75	3	50
16"	40	10	40	20	70	90	3	50
24"	50	10	40	25	75	100	4	50
30"	50	10	40	25	75	100	5	50
36"	50	10	40	25	75	100	5	50
42"	60	10	40	30	80	110	6	50
48"	75	10	35	37.5	82.5	120	6	50

DRAWING ASSUMES TYPE "B" SOIL

NO.	REVISION	DATE	APPR.

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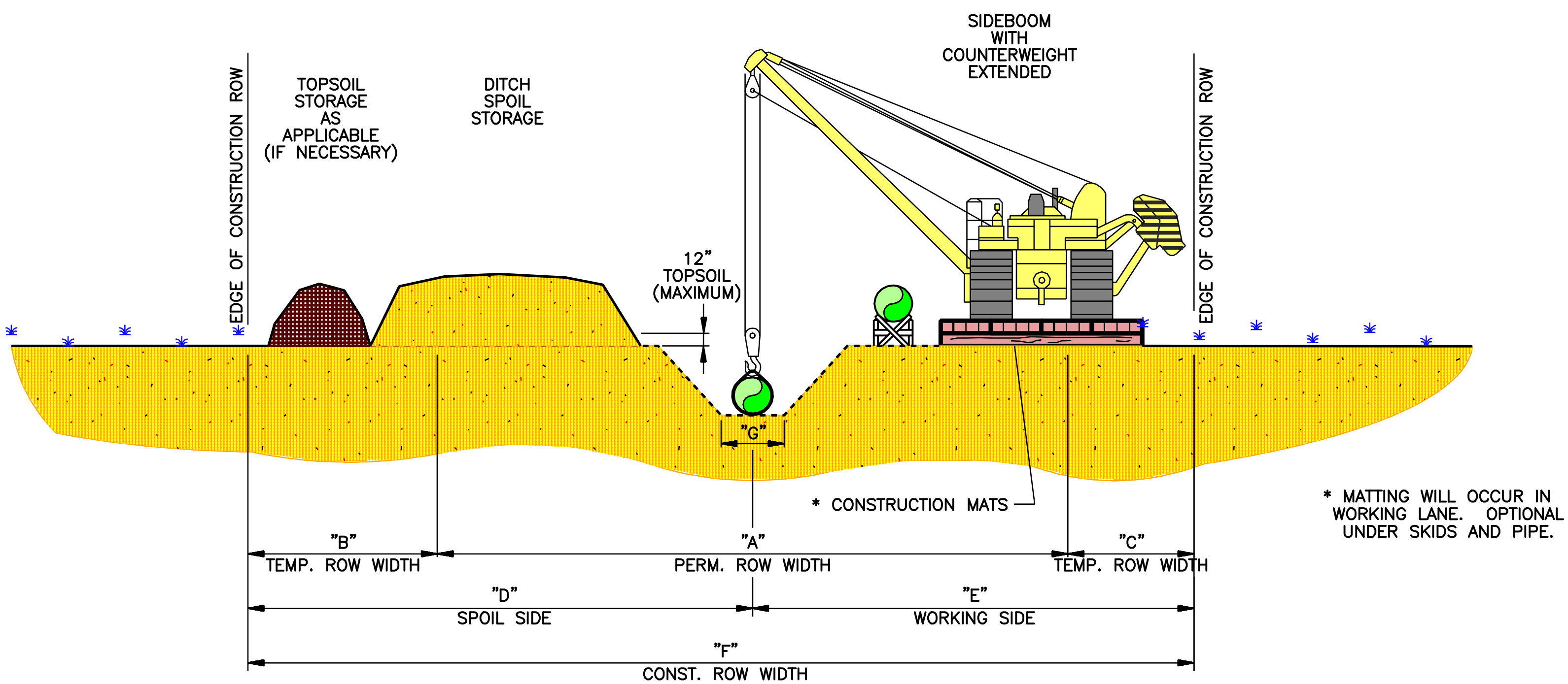
MAINLINE CONSTRUCTION PARALLEL TO POWER LINES RIGHT-OF-WAY

WILLBROS ENGINEERING/EPC
2087 E. 71st Street – Tulsa, OK 74136
(918) 496–0400

DRAWING NUMBER	SHEET
STD-INGAA-5	1 OF 1

WORKING AREA



* MATTING WILL OCCUR IN WORKING LANE. OPTIONAL UNDER SKIDS AND PIPE.

GENERAL NOTES:

1.) EXTRA DEPTH MAY BE REQUIRED FOR CONCRETE COATED PIPE OR WEIGHTS.

R.O.W. DIMENSIONS (FEET EXCEPT FOR DIAMETER, WHICH IS INCHES)

DIAMETER PIPE	A	B	C	D	E	F	G
12"	40	10	10	30	30	60	3
16"	40	10	10	30	30	60	3
24"	50	15	10	40	35	75	4
30"	50	15	10	40	35	75	5
36"	50	15	10	40	35	75	5
42"	60	15	10	45	40	85	6
48"	75	10	10	47.5	47.5	95	6

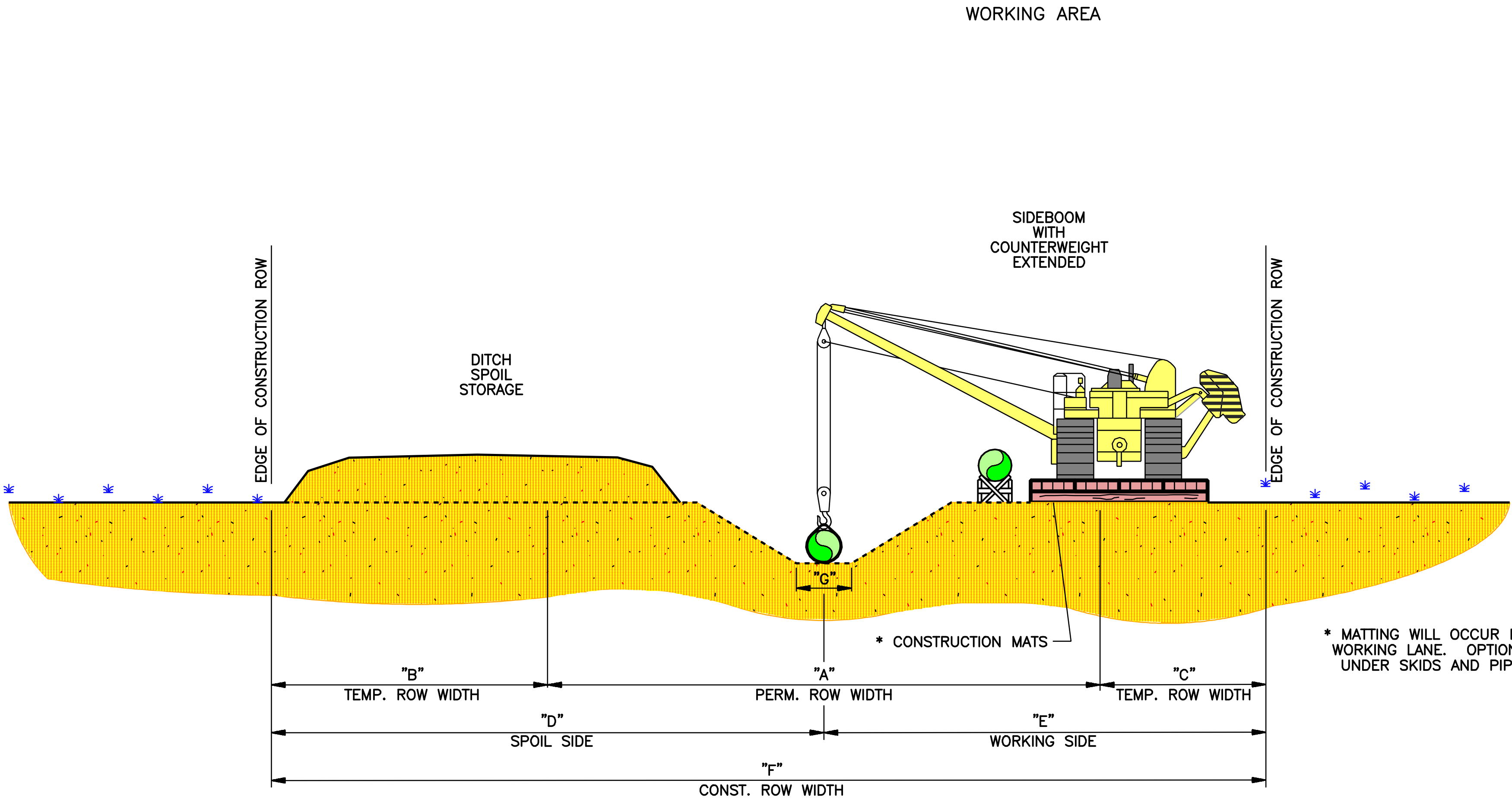
NO.	REVISION	DATE	APPR.

The INGAA Foundation

MAINLINE CONSTRUCTION
NON-PARALLEL CONSTRUCTION
WORKING AREA NON-SATURATED
WETLAND RIGHT-OF-WAY

WILLBROS ENGINEERING/EPC
2087 E. 71st Street – Tulsa, OK 74136
(918) 496-0400

DRAWING NUMBER	SHEET
STD-INGAA-6	1 OF 1



* MATTING WILL OCCUR IN WORKING LANE. OPTIONAL UNDER SKIDS AND PIPE.

GENERAL NOTES:

1.) EXTRA DEPTH MAY BE REQUIRED FOR CONCRETE COATED PIPE OR WEIGHTS.

R.O.W. DIMENSIONS (FEET EXCEPT FOR DIAMETER, WHICH IS INCHES)							
DIAMETER PIPE	A	B	C	D	E	F	G
12"	40	15	10	35	30	65	3
16"	40	15	10	35	30	65	3
24"	50	20	10	45	35	80	4
30"	50	20	10	45	35	80	5
36"	50	25	10	50	35	85	5
42"	60	25	10	55	40	95	6
48"	75	20	5	57.5	42.5	100	6

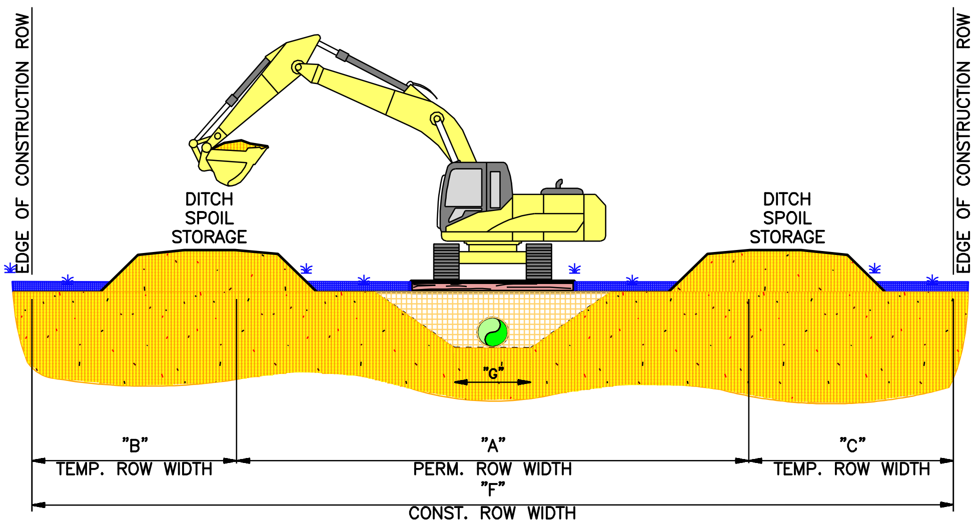
NO.	REVISION	DATE	APPR.

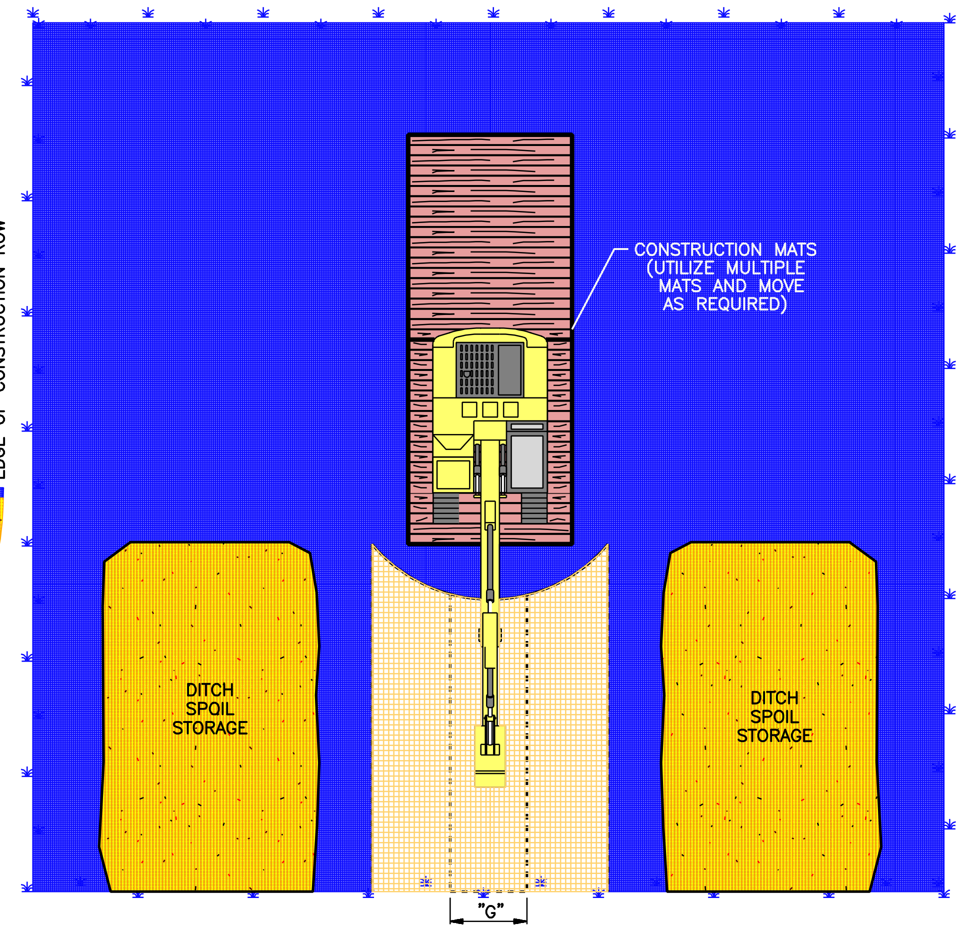
The INGAA Foundation

MAINLINE CONSTRUCTION
NON-PARALLEL CONSTRUCTION
WORKING AREA SATURATED
WETLAND RIGHT-OF-WAY

WILLBROS ENGINEERING/EPC
2087 E. 71st Street – Tulsa, OK 74136
(918) 496-0400

DRAWING NUMBER	SHEET
STD-INGAA-7	1 OF 1





NOTE:
EXTRA DEPTH MY BE REQUIRED FOR
CONCRETE COATED PIPE OR WEIGHTS

R.O.W. DIMENSIONS (FEET EXCEPT FOR DIAMETER, WHICH IS INCHES)

DIAMETER PIPE	A	B	C	F	G
12"	40	12.5	12.5	65	4
16"	40	12.5	12.5	65	4
24"	50	12.5	12.5	75	5
30"	50	12.5	12.5	75	5
36"	50	20	20	90	6
42"	50	20	20	90	6
48"	50	22.5	22.5	95	7

NO.	REVISION	DATE	APPR.

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2087 E. 71st Street – Tulsa, OK 74136
(918) 496–0400

The INGAA Foundation

MAINLINE CONSTRUCTION
NON-PARALLEL CONSTRUCTION
SUBMERGED WETLAND
RIGHT-OF-WAY

DRAWING NUMBER	SHEET
STD-INGAA-8	1 OF 1

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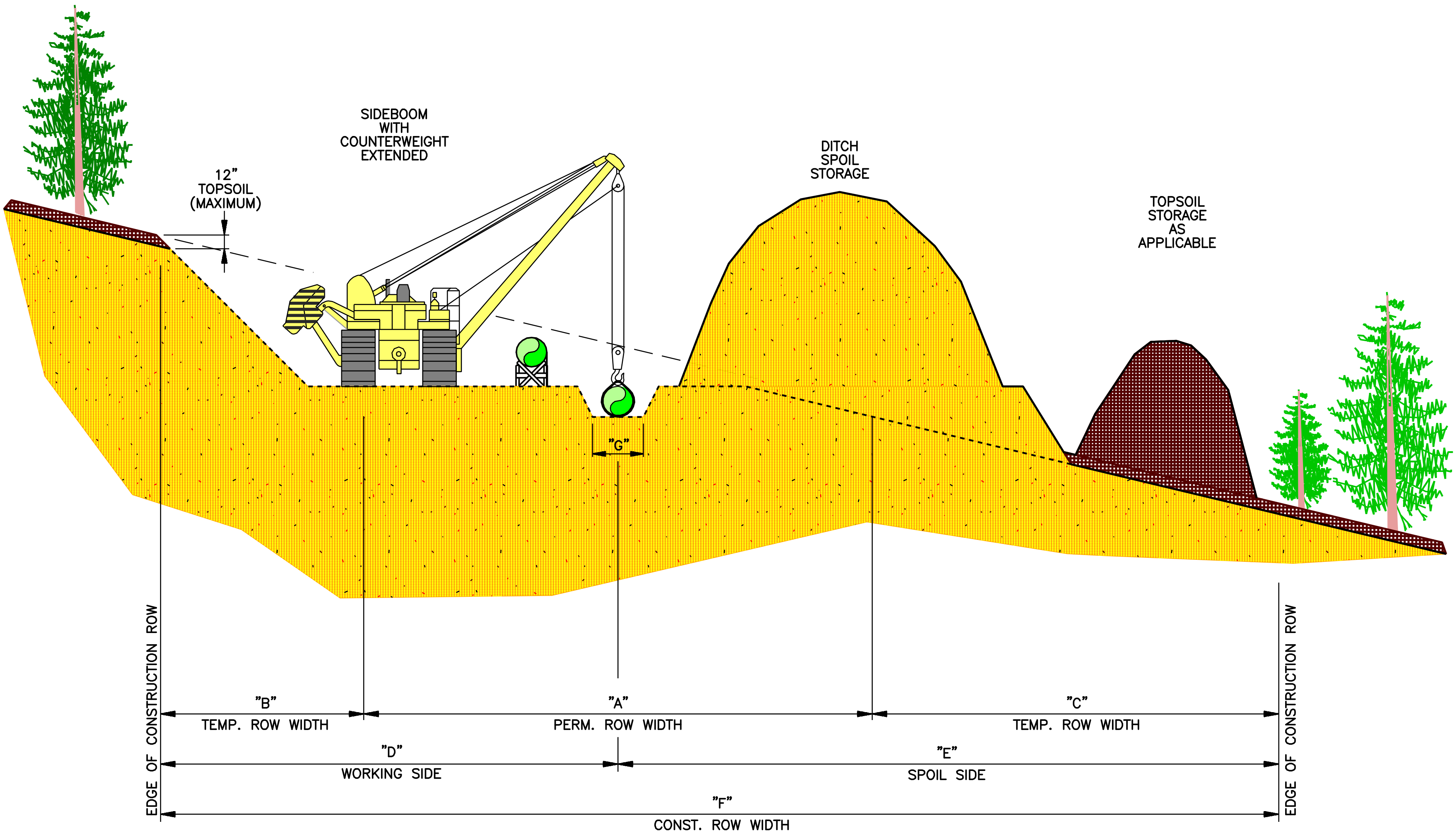


NOTE:
USED FOR SHORT AREAS WITH GOOD ACCESS

DRAWING ASSUMES TYPE "B" SOIL

R.O.W. DIMENSIONS (FEET EXCEPT FOR DIAMETER, WHICH IS INCHES)							
DIAMETER PIPE	A	B	C	D	E	F	G
12"	40	5	30	25	50	75	3
16"	40	10	40	30	60	90	3
24"	50	10	40	35	65	100	4
30"	50	10	40	35	65	100	5
36"	50	10	40	35	65	100	5
42"	60	10	40	40	70	110	6
48"	75	10	35	47.5	72.5	120	6

NO.	REVISION	DATE	APPR.

The INGAA Foundation

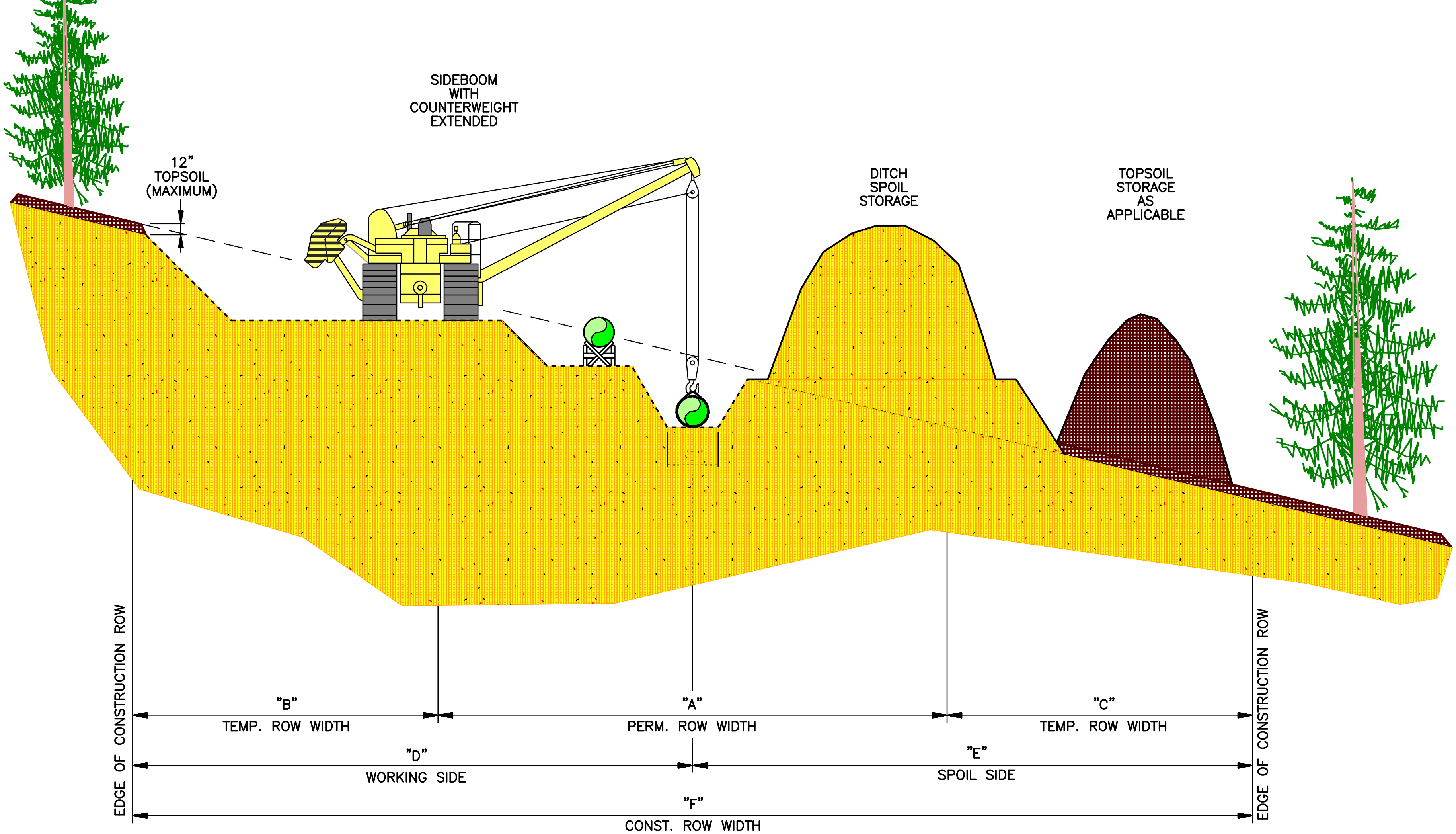
MAINLINE CONSTRUCTION
NON-PARALLEL CONSTRUCTION
TYPICAL SIDE HILL
RIGHT-OF-WAY

WILLBROS ENGINEERING/EPC
2087 E. 71st Street – Tulsa, OK 74136
(918) 496-0400

DRAWING NUMBER	SHEET
STD-INGAA-9	1 OF 1

GENERAL NOTES:

1.) CONSTRUCTION RIGHT–OF–WAY MAY BE EXPANDED UP TO 25 FEET WITHOUT PRIOR APPROVAL.



R.O.W. DIMENSIONS (FEET EXCEPT FOR DIAMETER, WHICH IS INCHES)							
DIAMETER PIPE	A	B	C	D	E	F	G
12"	40	5	30	25	50	75	3
16"	40	10	40	30	60	90	3
24"	50	10	40	35	65	100	4
30"	50	10	40	35	65	100	5
36"	50	10	40	35	65	100	5
42"	60	10	40	40	70	110	6
48"	75	10	35	47.5	72.5	120	6

DRAWING ASSUMES TYPE "B" SOIL

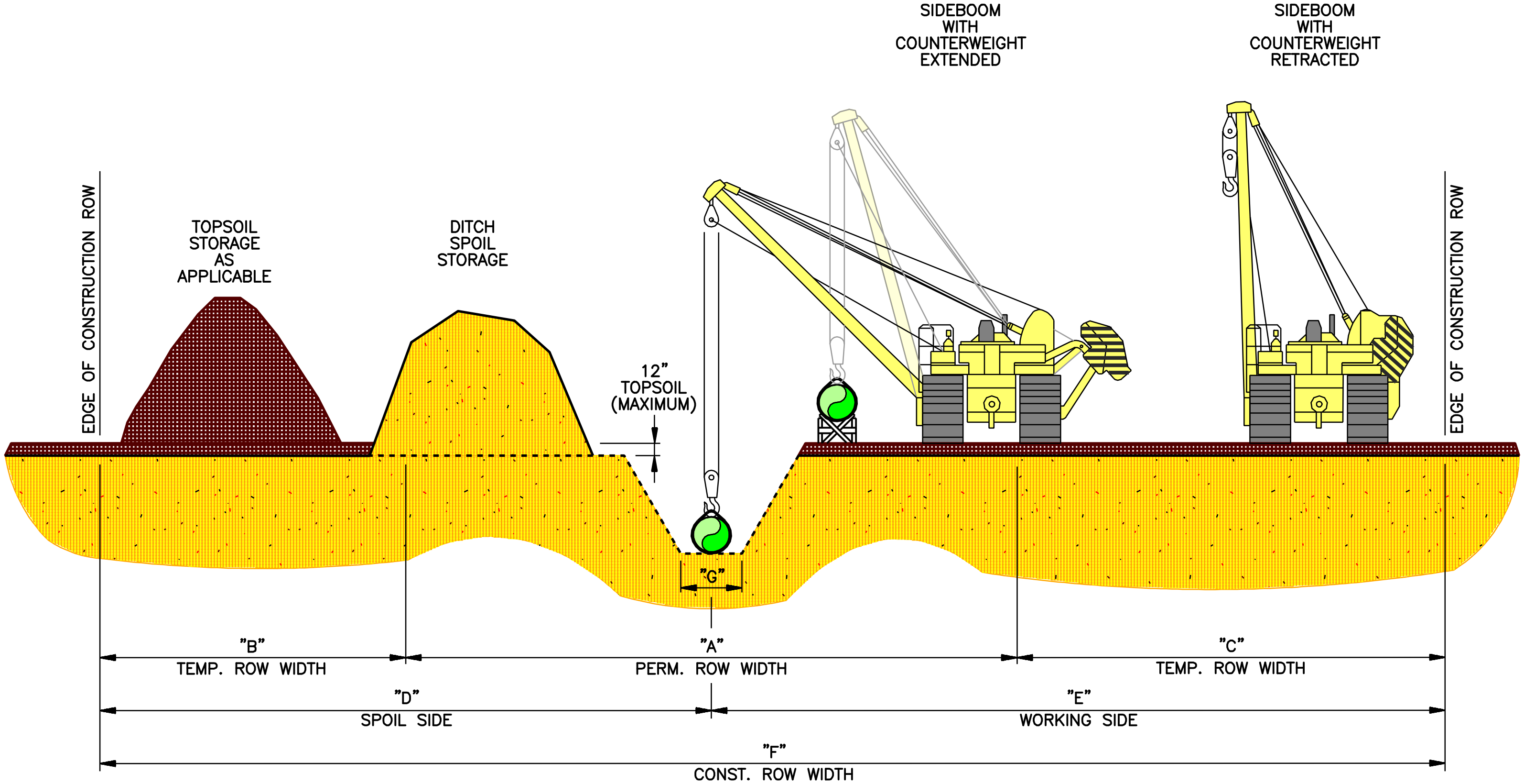
NO.	REVISION	DATE	APPR.

The INGAA Foundation

MAINLINE CONSTRUCTION NON-PARALLEL CONSTRUCTION TYPICAL TWO TONE RIGHT-OF-WAY

WILLBROS ENGINEERING/EPC
2087 E. 71st Street – Tulsa, OK 74136
(918) 496–0400

DRAWING NUMBER	SHEET
STD-INGAA-10	1 OF 1



R.O.W. DIMENSIONS (FEET EXCEPT FOR DIAMETER, WHICH IS INCHES)							
DIAMETER PIPE	A	B	C	D	E	F	G
12"	40	15	30	35	50	85	3
16"	40	20	40	40	60	100	3
24"	50	20	40	45	65	110	4
30"	50	20	40	45	65	110	5
36"	50	25	40	50	65	115	5
42"	60	30	40	60	70	130	6
48"	75	30	35	67.5	72.5	140	6

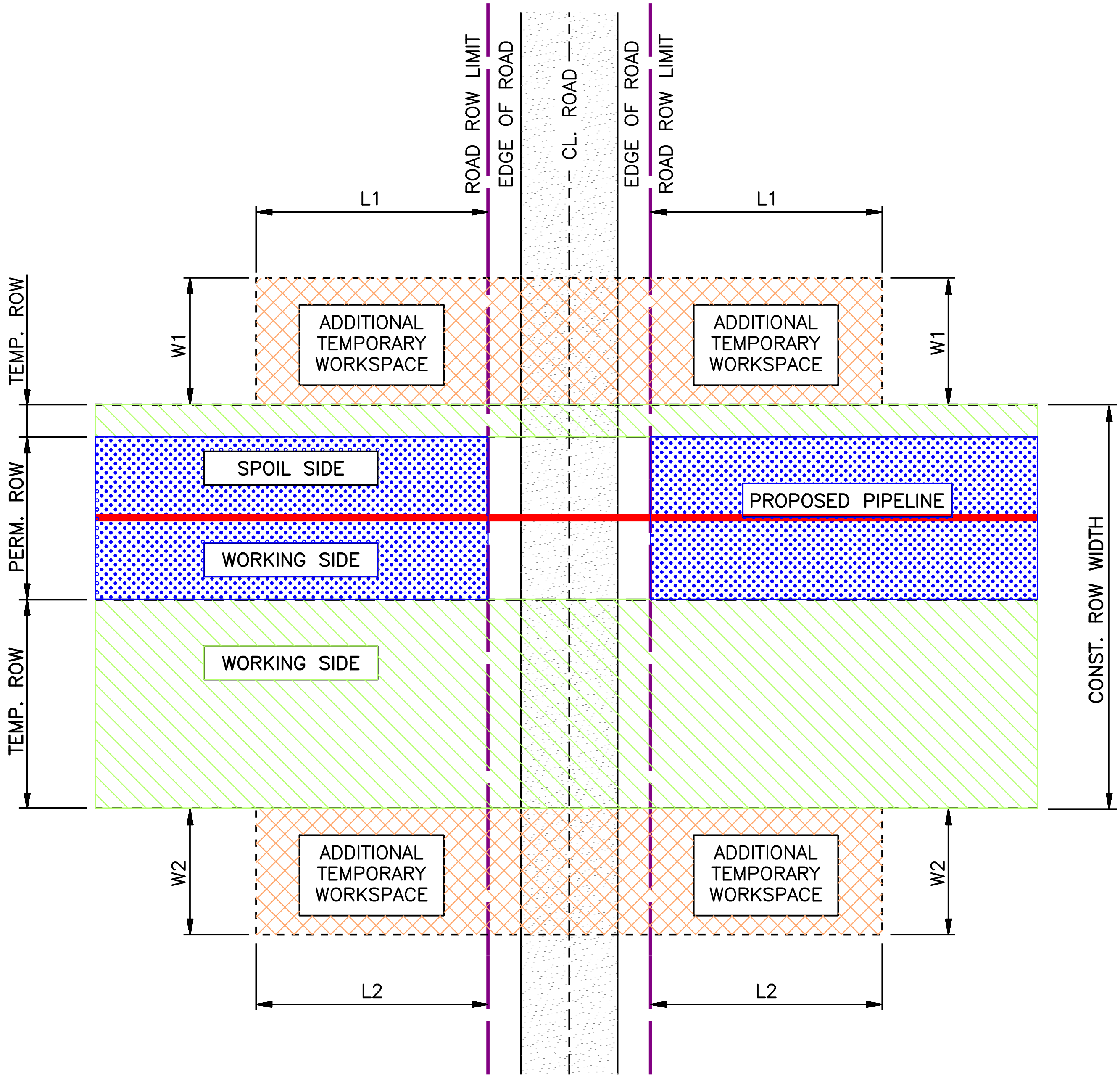
NO.	REVISION	DATE	APPR.

The INGAA Foundation

MAINLINE CONSTRUCTION
NON-PARALLEL CONSTRUCTION
EXTRA DEPTH DITCH (5' COVER)
RIGHT-OF-WAY

WILLBROS ENGINEERING/EPC
2087 E. 71st Street – Tulsa, OK 74136
(918) 496-0400

DRAWING NUMBER	SHEET
STD-INGAA-11	1 OF 1



NO.	REVISION	DATE	APPR.

WILLBROS ENGINEERING/EPC
2087 E. 71st Street – Tulsa, OK 74136
(918) 496-0400

The INGAA Foundation

MAINLINE CONSTRUCTION
ROAD CROSSING OPEN CUT
RIGHT-OF-WAY

DRAWING NUMBER	SHEET
STD-INGAA-12	1 OF 1

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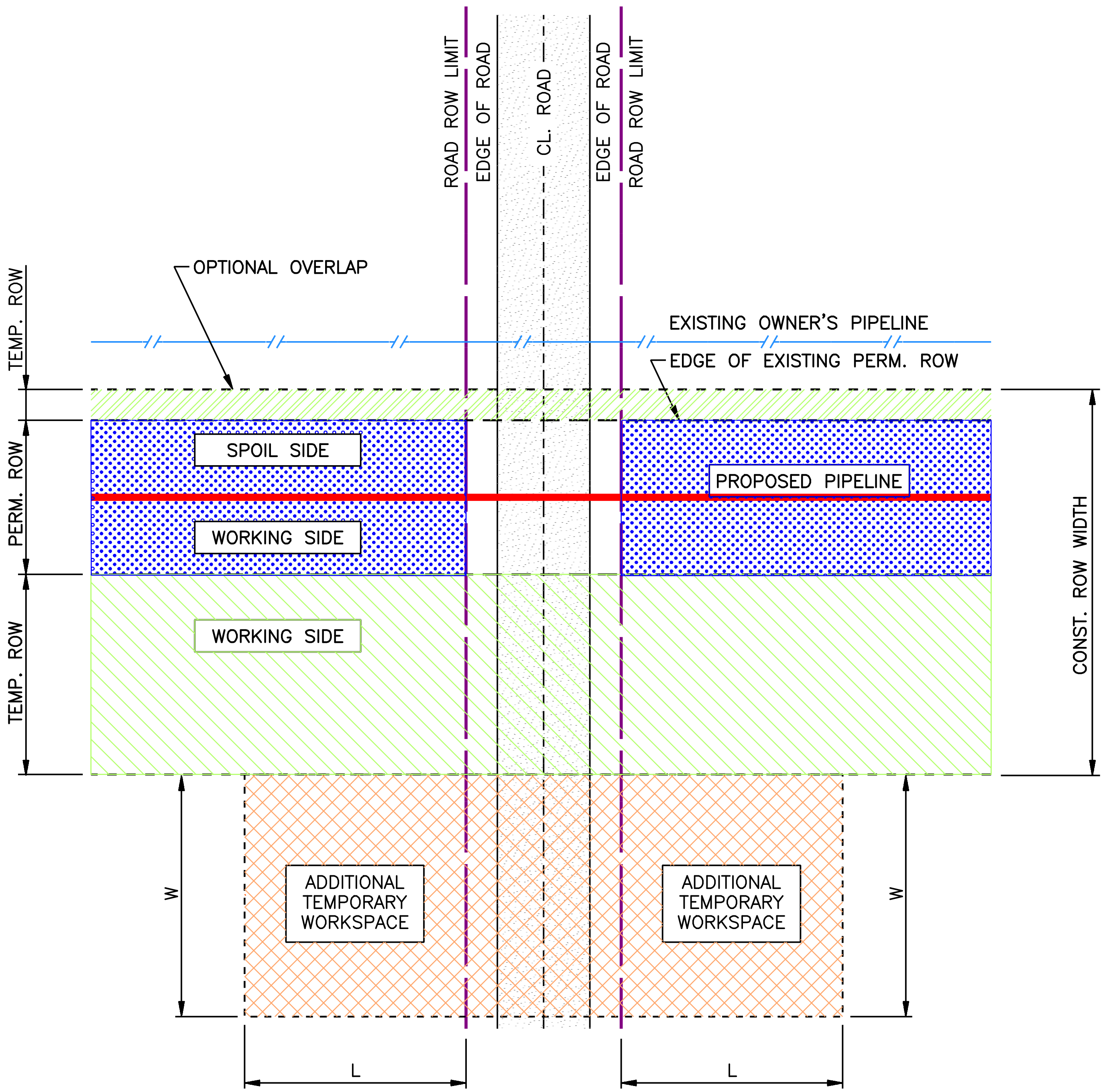


GENERAL NOTES:

1.) PORTION OF EXISTING R.O.W. MAY BE UTILIZED BY AGREEMENT OR REGULATORY CONDITION.

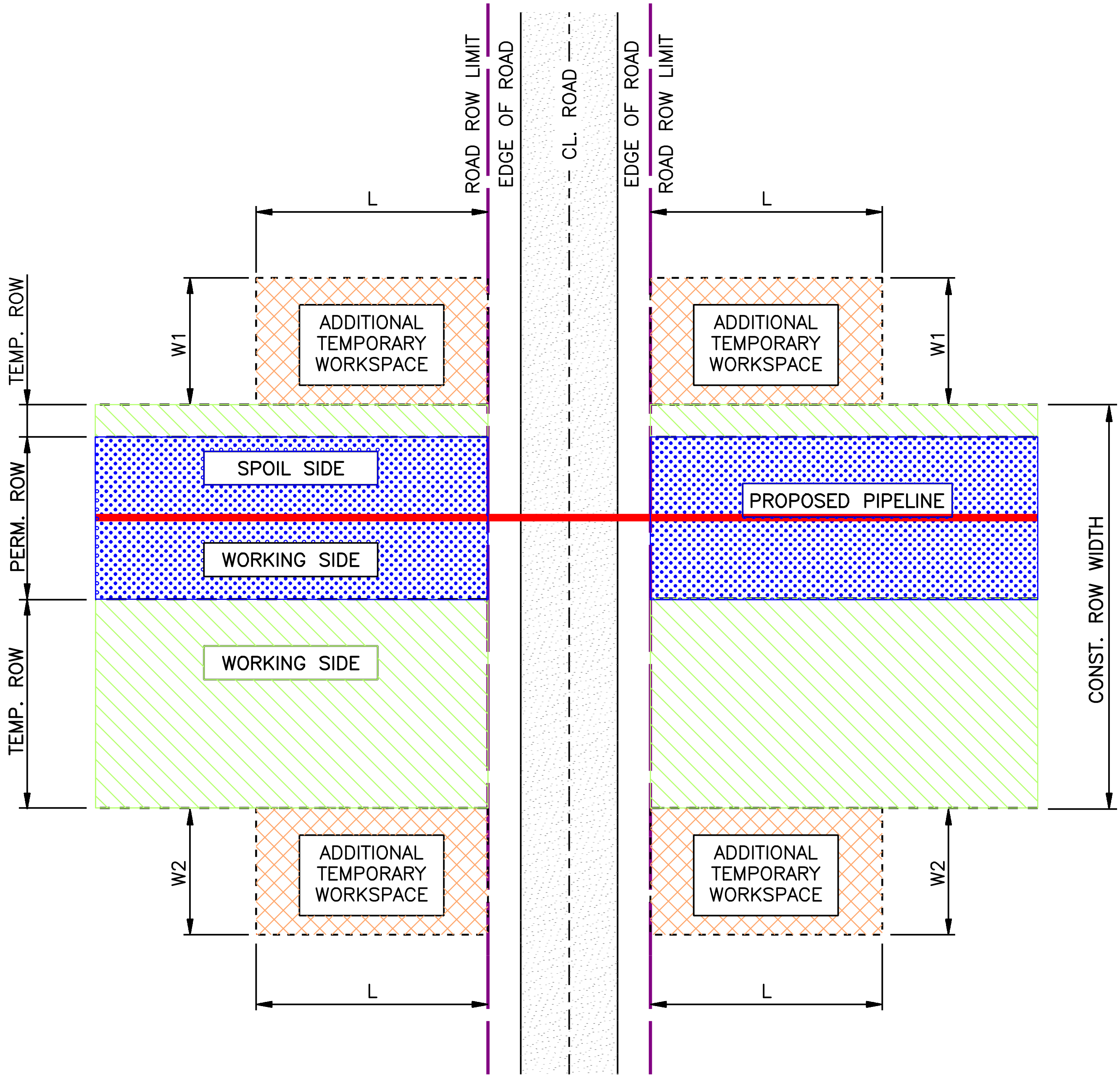
NO.	REVISION	DATE	APPR.

WILLBROS ENGINEERING/EPC
2087 E. 71st Street – Tulsa, OK 74136
(918) 496-0400

The INGAA Foundation

MAINLINE CONSTRUCTION ROAD CROSSING OPEN CUT PARALLEL TO PIPELINE RIGHT-OF-WAY

DRAWING NUMBER	SHEET
STD-INGAA-13	1 OF 1



GENERAL NOTES:

1.) ROAD MAY BE CROSSED BY CONSTRUTION SPREAD AS ALLOWED BY PERMIT.

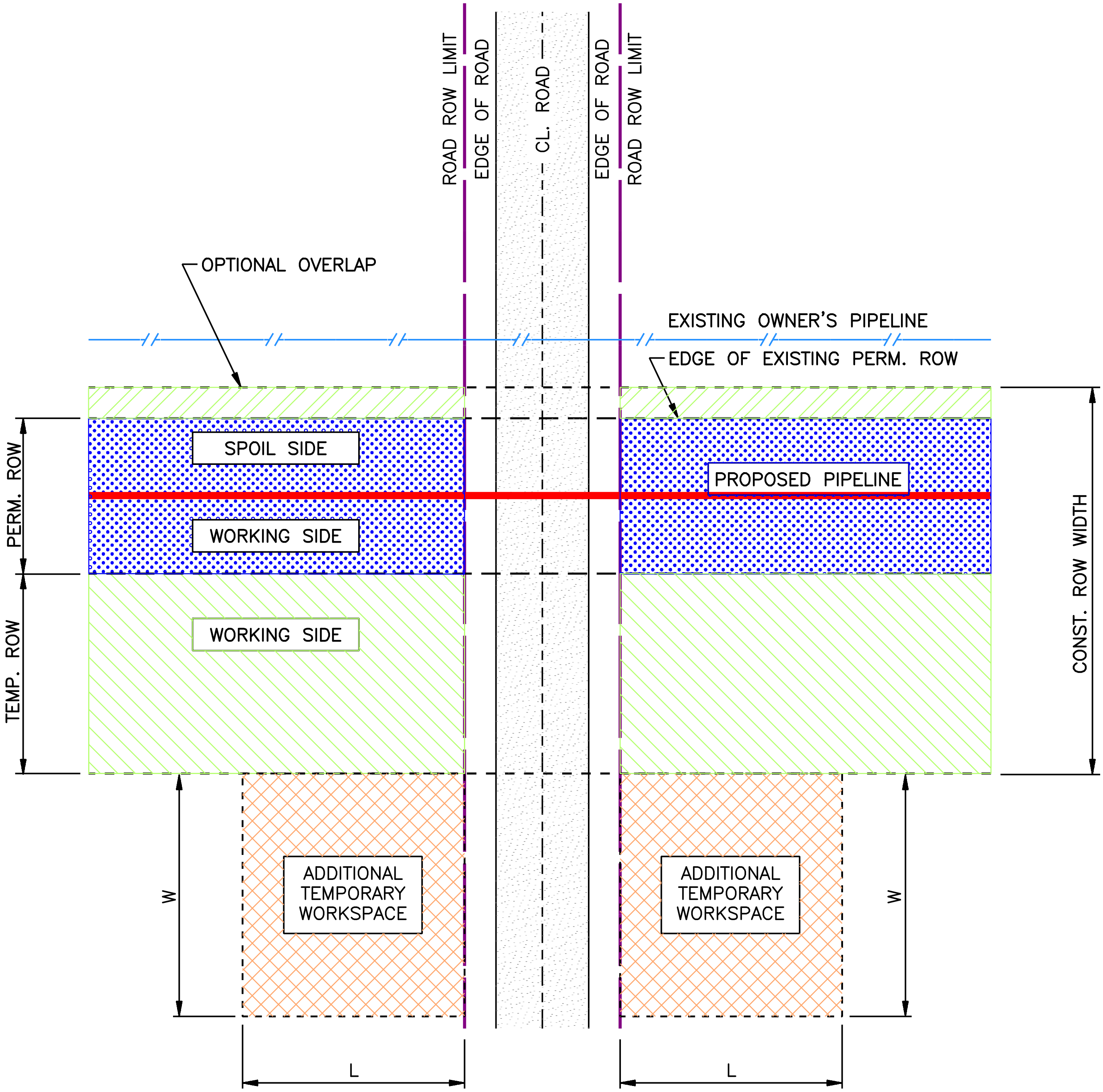
NO.	REVISION	DATE	APPR.

WILLBROS ENGINEERING/EPC
2087 E. 71st Street – Tulsa, OK 74136
(918) 496-0400

The INGAA Foundation

MAINLINE CONSTRUCTION
ROAD CROSSING BORED
RIGHT-OF-WAY

DRAWING NUMBER	SHEET
STD-INGAA-14	1 OF 1



GENERAL NOTES:

1.) PORTION OF EXISTING R.O.W. MAY BE UTILIZED BY AGREEMENT OR REGULATORY CONDITION.

NO.	REVISION	DATE	APPR.

WILLBROS ENGINEERING/EPC
2087 E. 71st Street – Tulsa, OK 74136
(918) 496-0400

The INGAA Foundation

MAINLINE CONSTRUCTION
ROAD CROSSING BORED
PARALLEL TO PIPELINE
RIGHT-OF-WAY

DRAWING NUMBER	SHEET
STD-INGAA-15	1 OF 1

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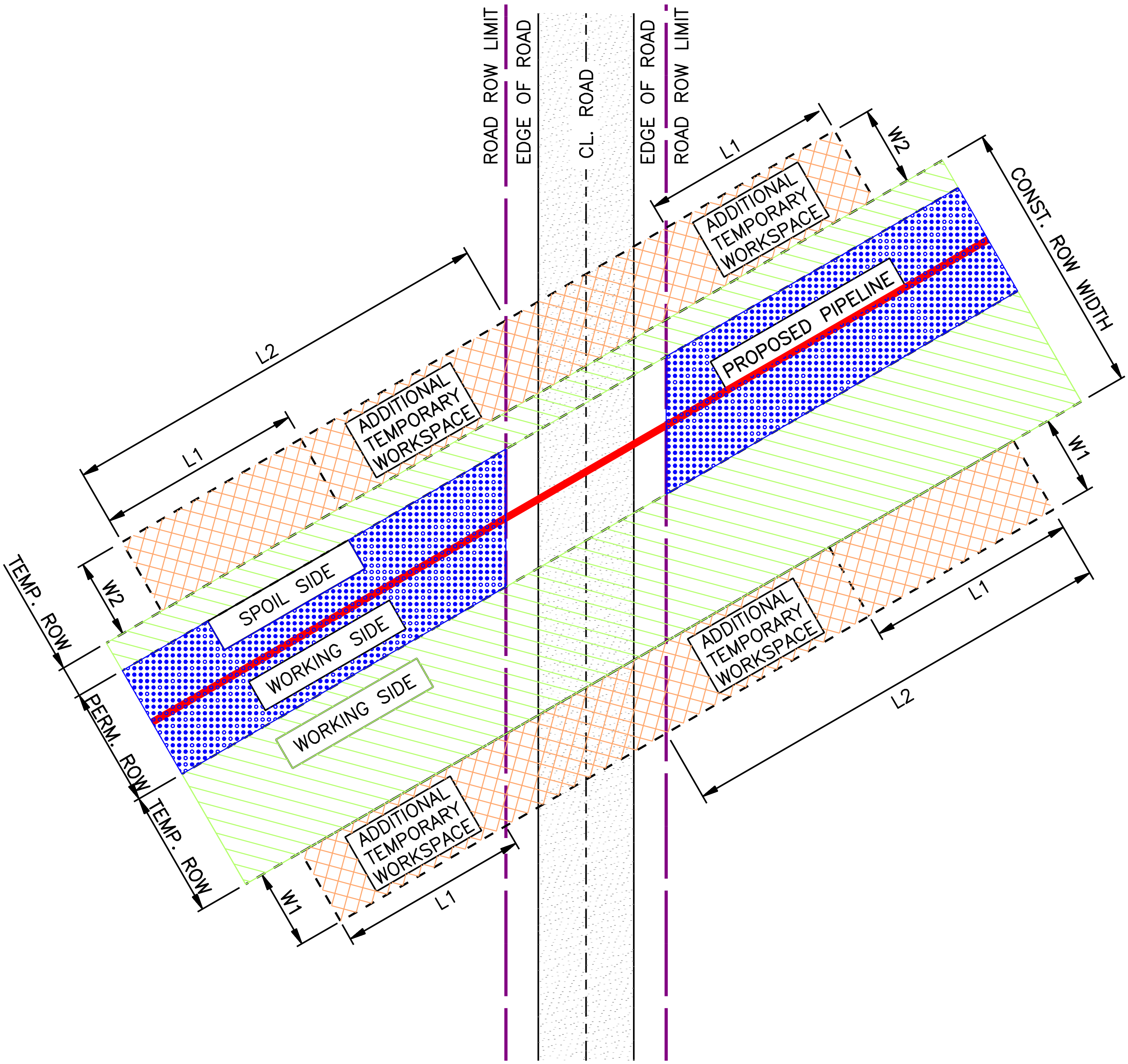

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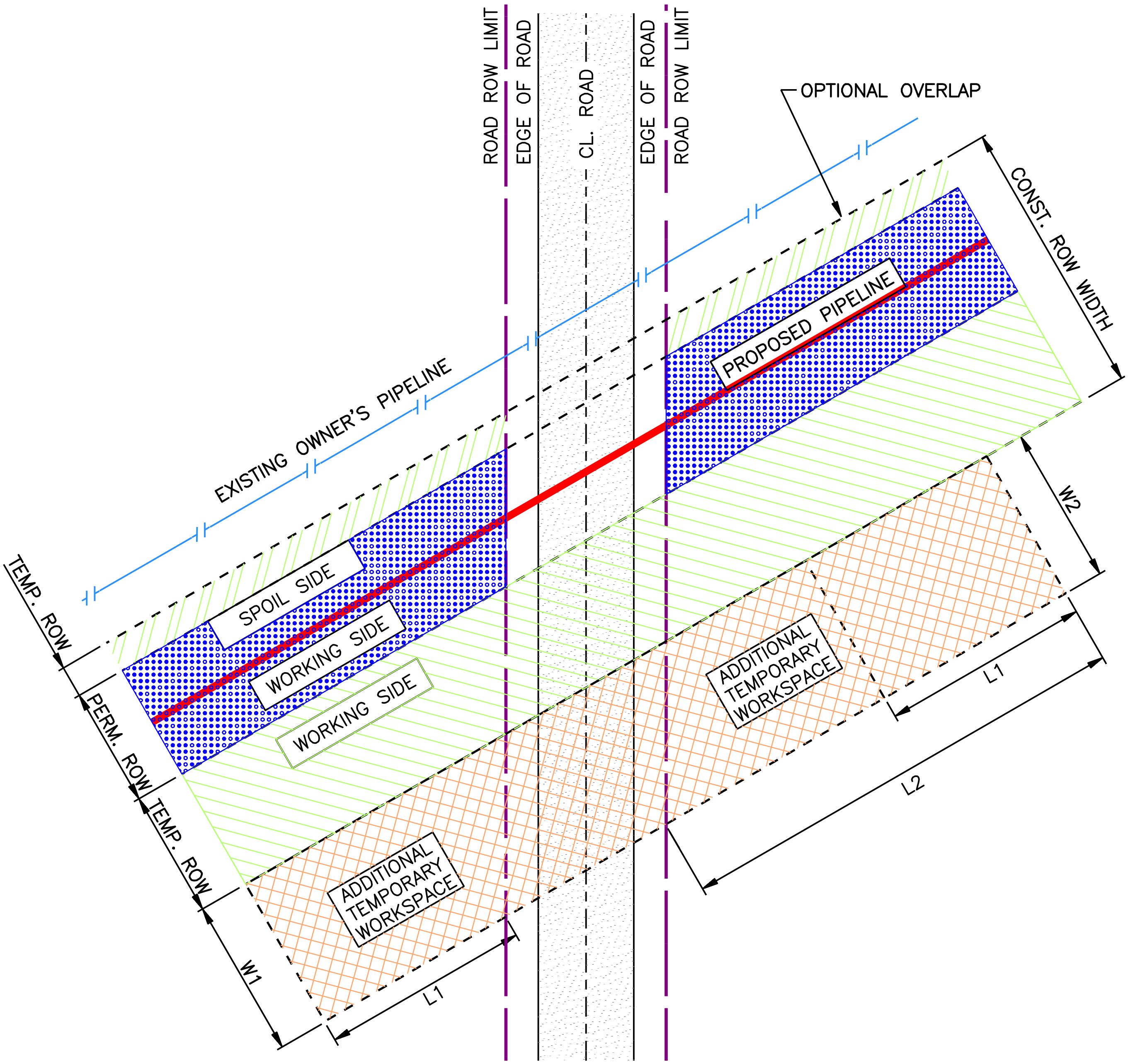
NO.	REVISION	DATE	APPR.

WILLBROS ENGINEERING/EPC
2087 E. 71st Street – Tulsa, OK 74136
(918) 496-0400

The INGAA Foundation

MAINLINE CONSTRUCTION
ROAD CROSSING OPEN CUT
(30 DEGREE CROSSING)
RIGHT-OF-WAY

DRAWING NUMBER	SHEET
STD-INGAA-16	1 OF 1



GENERAL NOTES:

1.) PORTION OF EXISTING R.O.W. MAY BE UTILIZED BY AGREEMENT OR REGULATORY CONDITION.

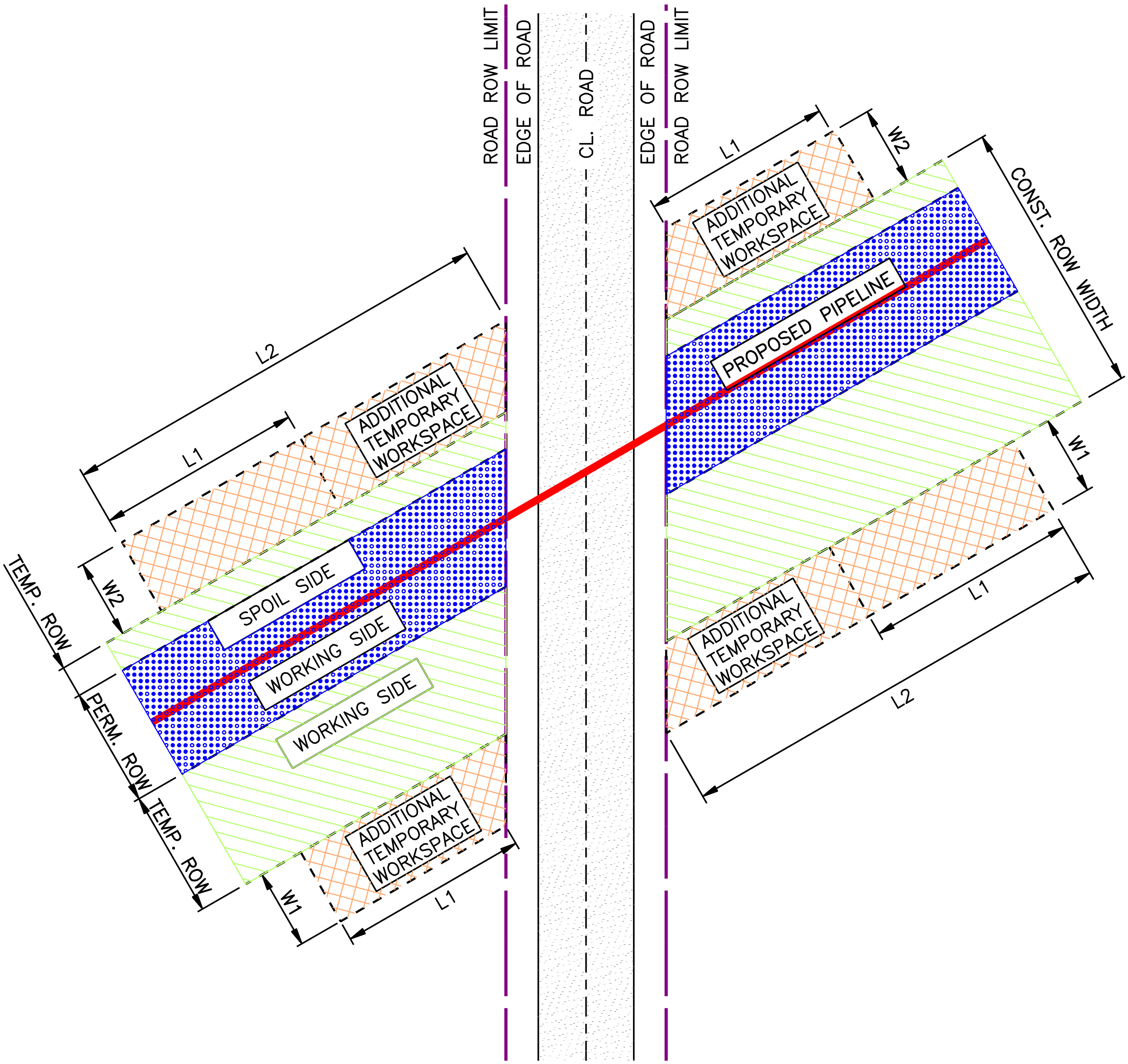
NO.	REVISION	DATE	APPR.

WILLBROS ENGINEERING/EPC
2087 E. 71st Street – Tulsa, OK 74136
(918) 496-0400

The INGAA Foundation

MAINLINE CONSTRUCTION ROAD CROSSING OPEN CUT PARALLEL TO PIPELINE (30 DEGREE CROSSING) RIGHT-OF-WAY

DRAWING NUMBER	SHEET
STD-INGAA-17	1 OF 1



GENERAL NOTES:

1.) PORTION OF EXISTING R.O.W. MAY BE UTILIZED BY AGREEMENT OR REGULATORY CONDITION.

NO.	REVISION	DATE	APPR.

WILLBROS ENGINEERING/EPC
2087 E. 71st Street – Tulsa, OK 74136
(918) 496-0400

The INGAA Foundation

MAINLINE CONSTRUCTION
ROAD CROSSING BORED
(30 DEGREE CROSSING)
RIGHT-OF-WAY

DRAWING NUMBER	SHEET
STD-INGAA-18	1 OF 1

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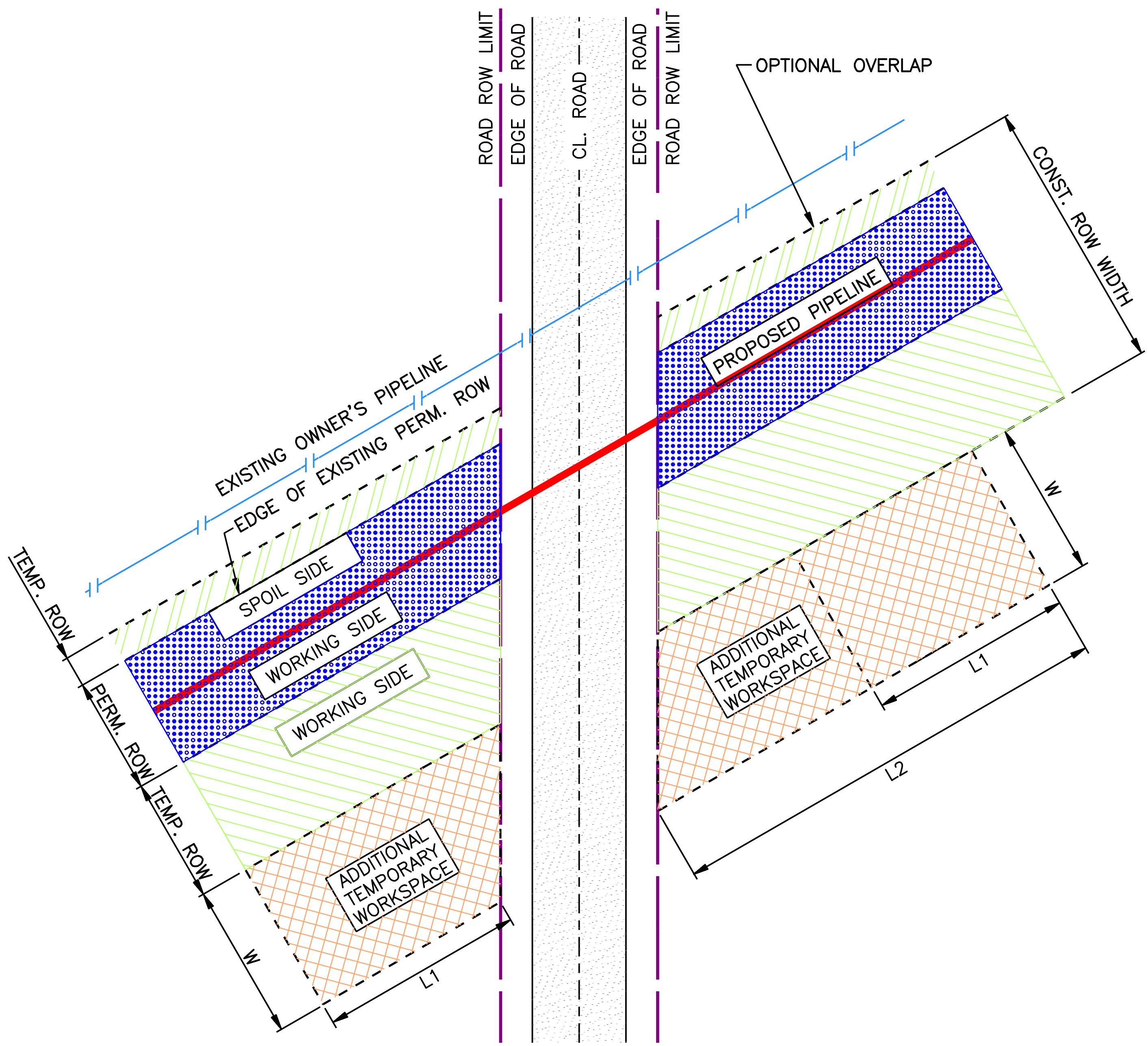


GENERAL NOTES:

1.) PORTION OF EXISTING R.O.W. MAY BE UTILIZED BY AGREEMENT OR REGULATORY CONDITION.

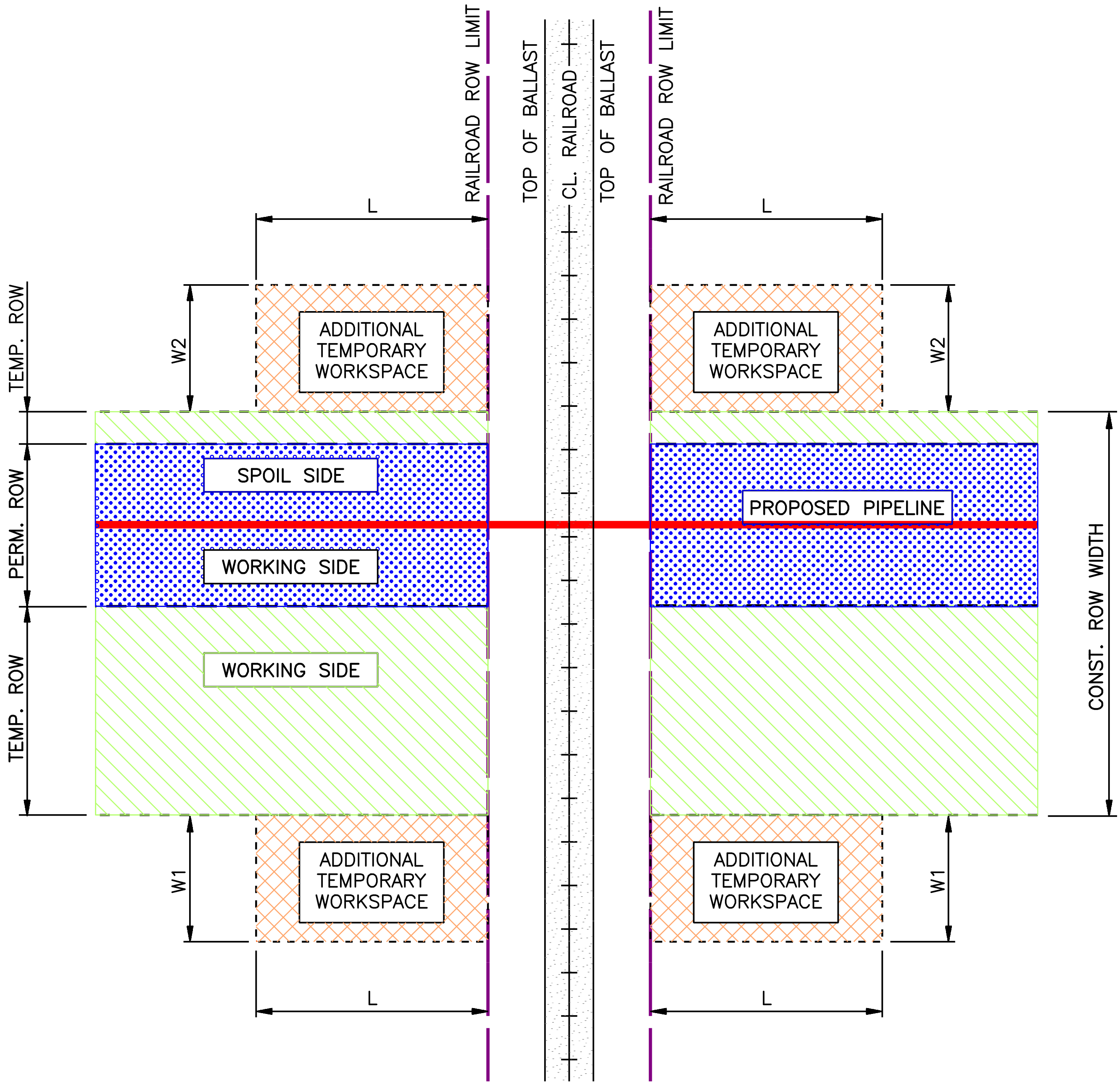
NO.	REVISION	DATE	APPR.

WILLBROS ENGINEERING/EPC
2087 E. 71st Street – Tulsa, OK 74136
(918) 496-0400

The INGAA Foundation

MAINLINE CONSTRUCTION ROAD CROSSING BORED PARALLEL TO PIPELINE (30 DEGREE CROSSING) RIGHT-OF-WAY

DRAWING NUMBER	SHEET
STD-INGAA-19	1 OF 1



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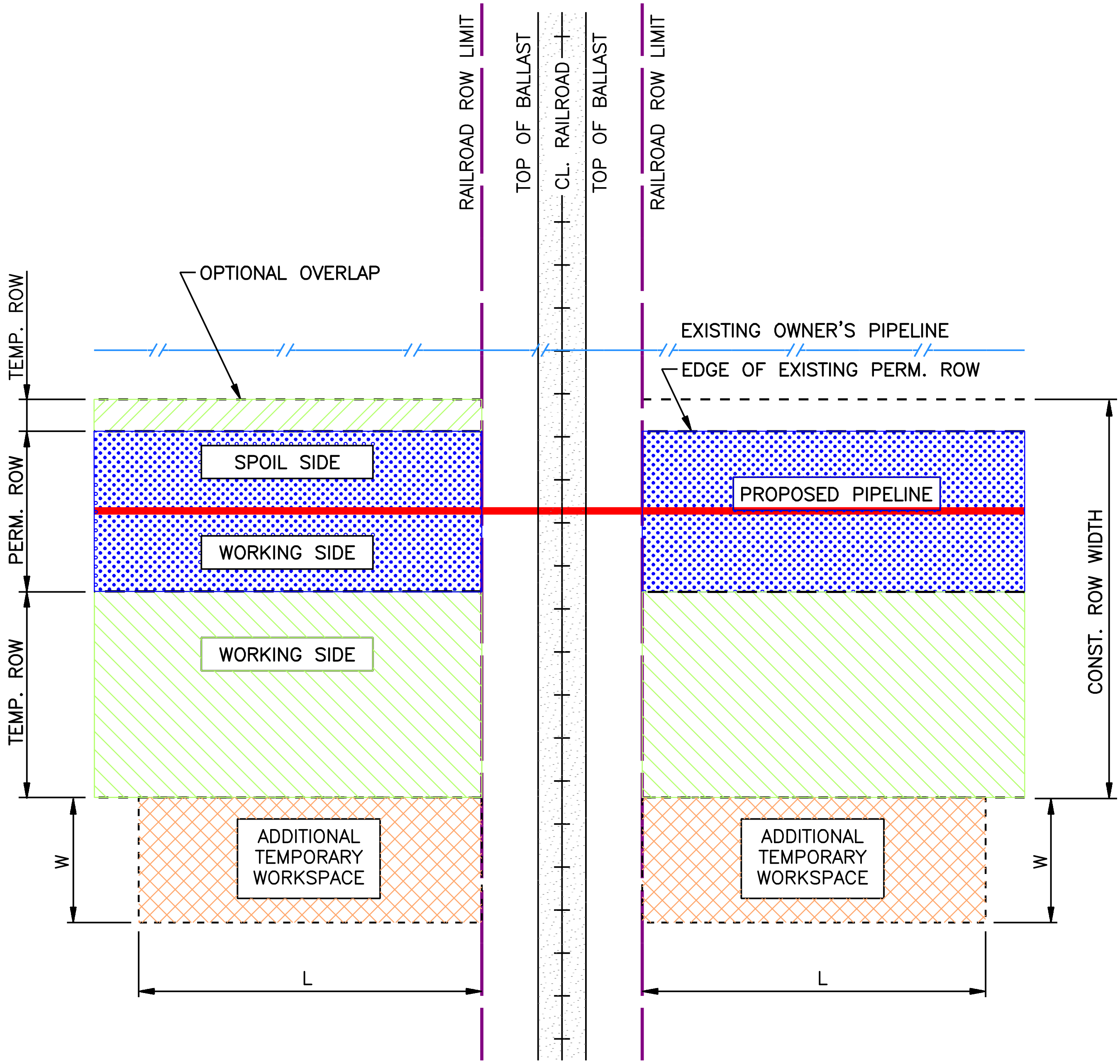
The INGAA Foundation

MAINLINE CONSTRUCTION
RAILROAD CROSSING BORED
RIGHT-OF-WAY

DRAWING NUMBER	SHEET
STD-INGAA-20	1 OF 1



GENERAL NOTES:

1.) PORTION OF EXISTING R.O.W. MAY BE UTILIZED BY AGREEMENT OR REGULATORY CONDITION.

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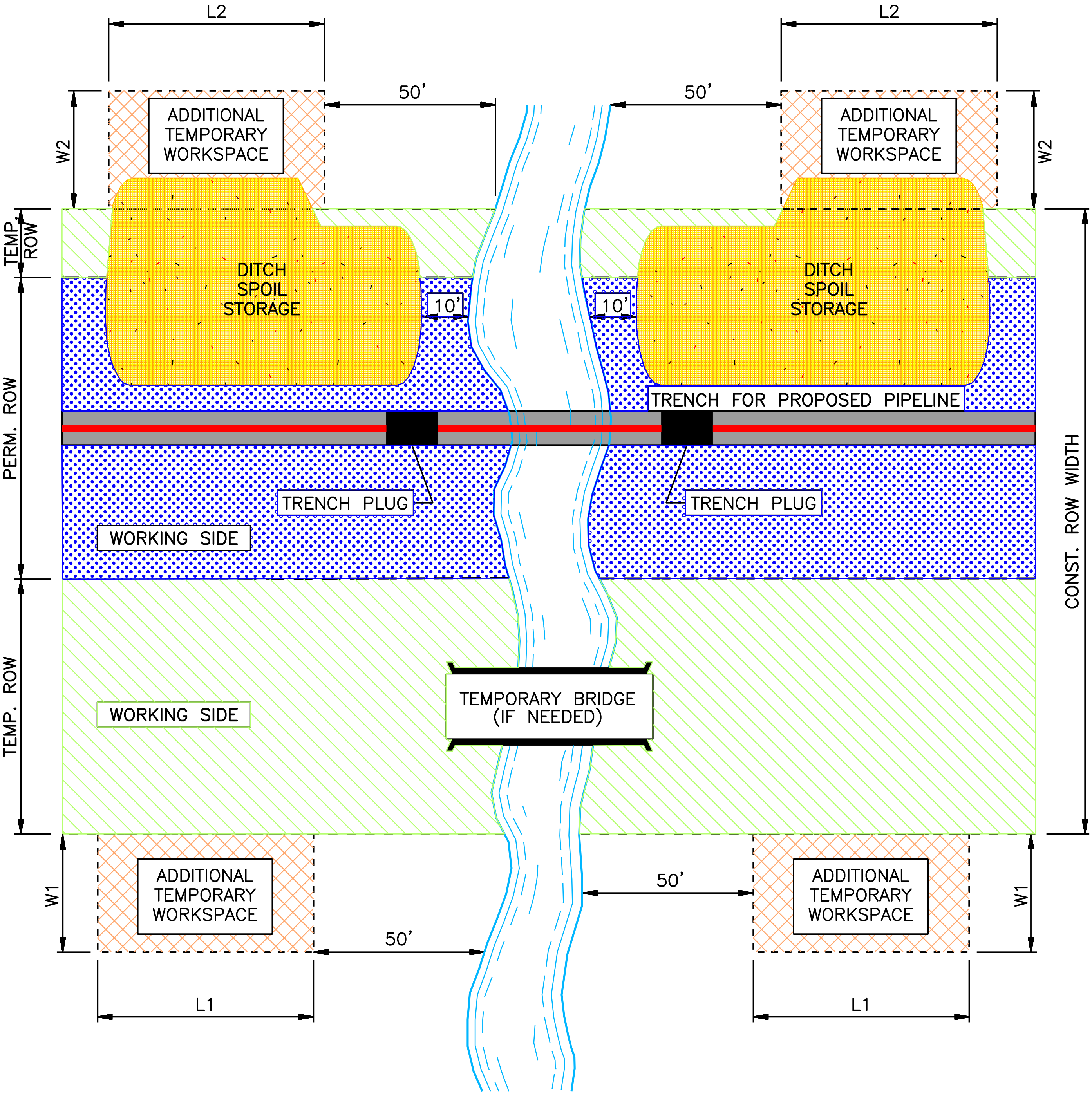
MAINLINE CONSTRUCTION
BORED RAILROAD CROSSING
PARALLEL TO PIPELINE
RIGHT-OF-WAY

DRAWING NUMBER	SHEET
STD-INGAA-21	1 OF 1



NO.	REVISION	DATE	APPR.

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MAINLINE CONSTRUCTION
WATERBODY CROSSING
OPEN CUT - WET DITCH
RIGHT-OF-WAY

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DRAWING NUMBER	SHEET
STD-INGAA-22	1 OF 1

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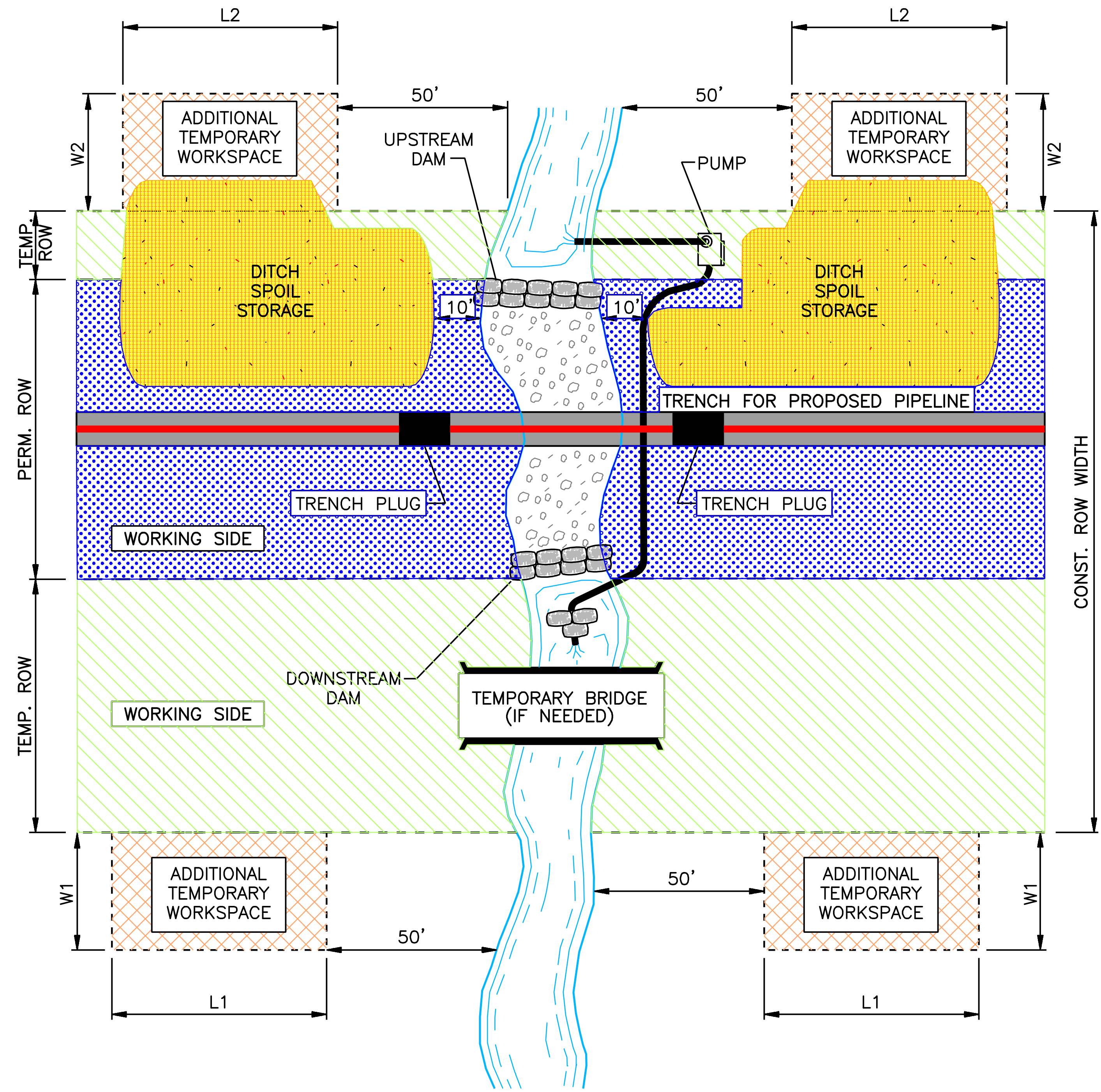

NO.	REVISION	DATE	APPR.

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MAINLINE CONSTRUCTION
WATERBODY CROSSING
OPEN CUT – DAM AND PUMP
RIGHT-OF-WAY

DRAWING NUMBER	SHEET
STD-INGAA-23	1 OF 1

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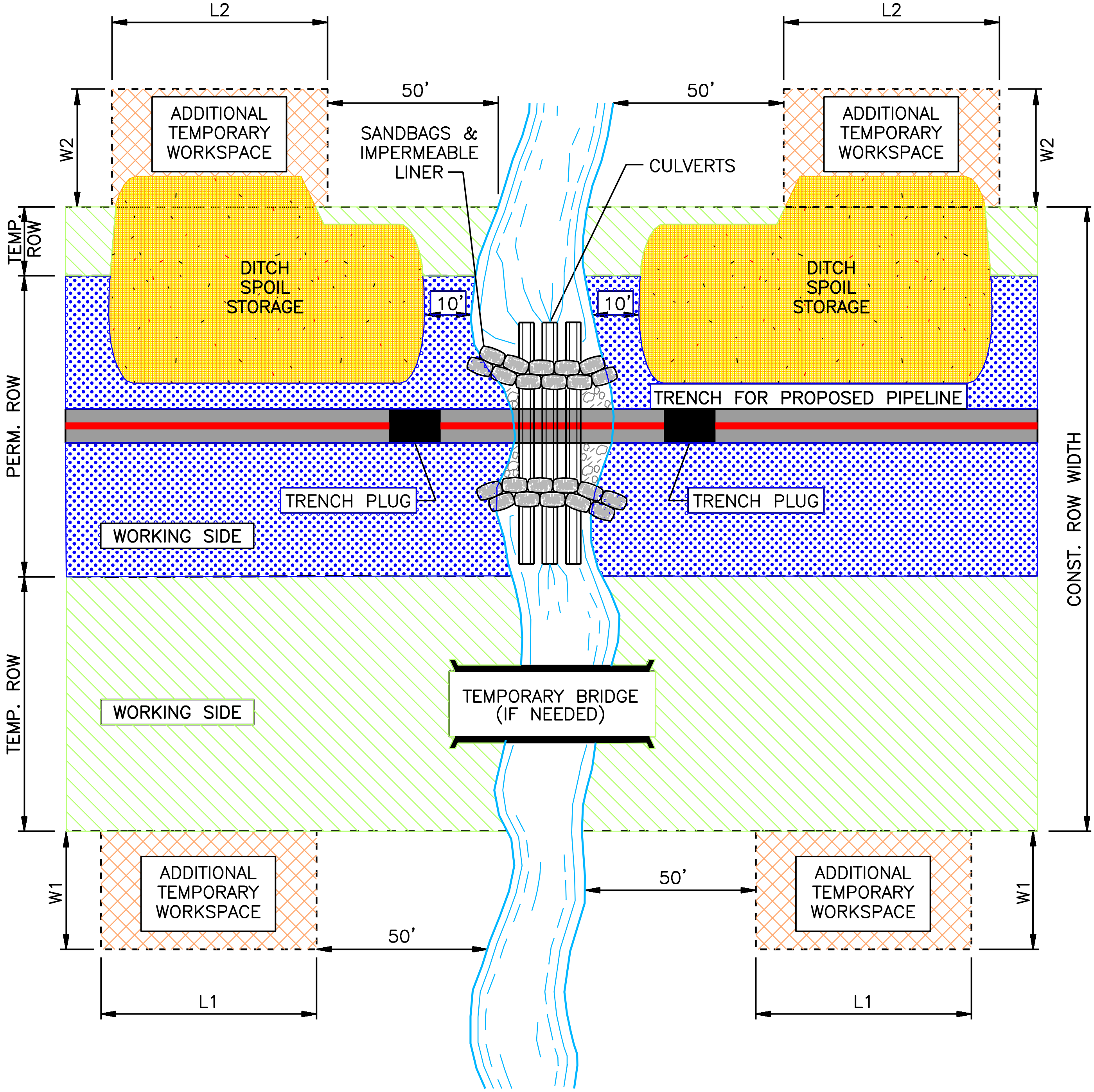

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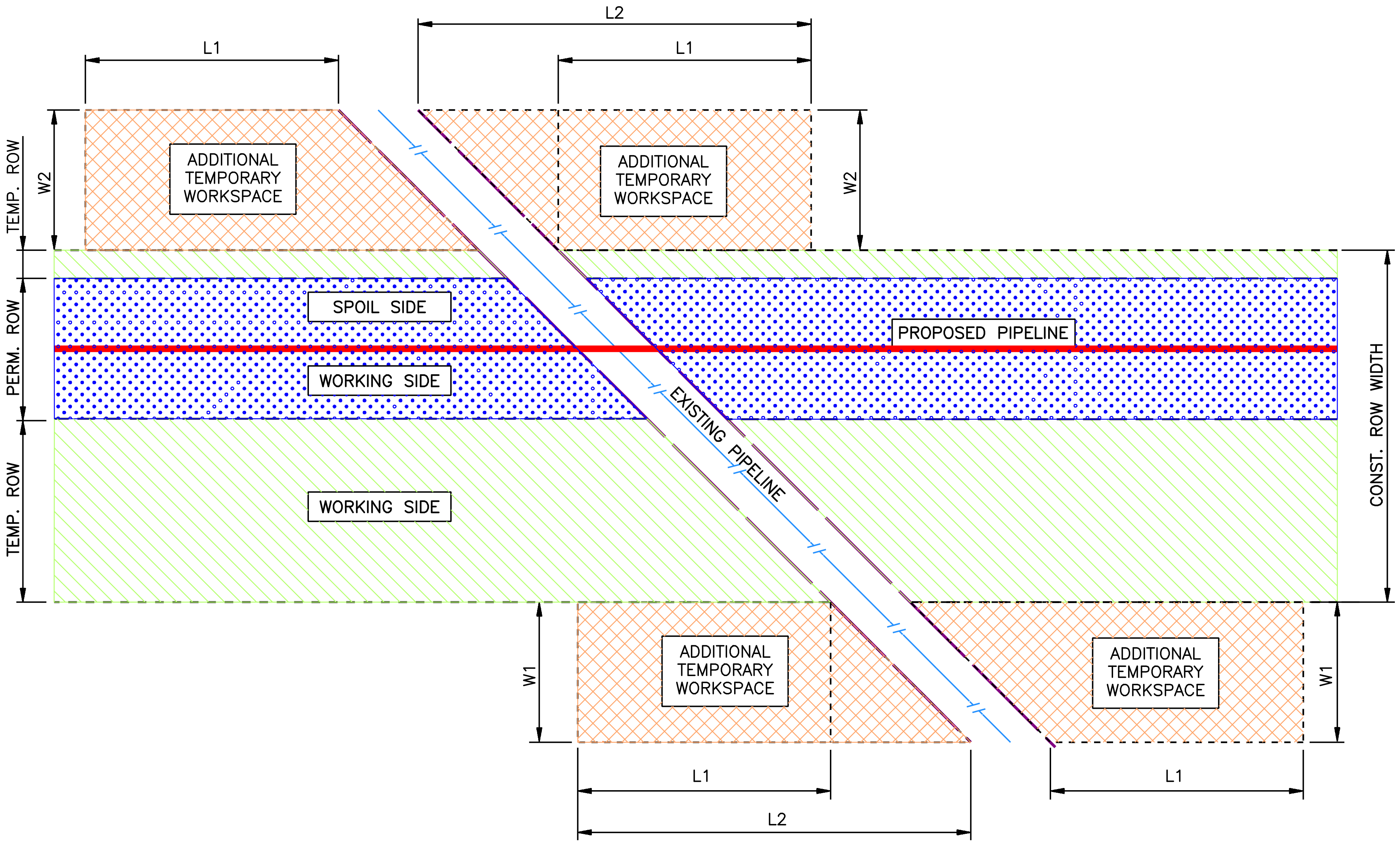
MAINLINE CONSTRUCTION
WATERBODY CROSSING
OPEN CUT – FLUME
RIGHT-OF-WAY

DRAWING NUMBER	SHEET
STD-INGAA-24	1 OF 1



GENERAL NOTES:

1.) DIMENSIONS DEPENDENT ON PROPOSED AND EXISTING PIPELINE DIAMETERS, BURIAL DEPTHS AND LOCAL SITE SPECIFIC CONDITIONS.

2.) TRAVEL LANE ON WORKING SIDE TO BE MATTED AS REQUIRED BY EXISTING PIPELINE COMPANY REQUIREMENTS AND LOCAL CONDITIONS.

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MAINLINE CONSTRUCTION
PIPELINE CROSSING
RIGHT-OF-WAY

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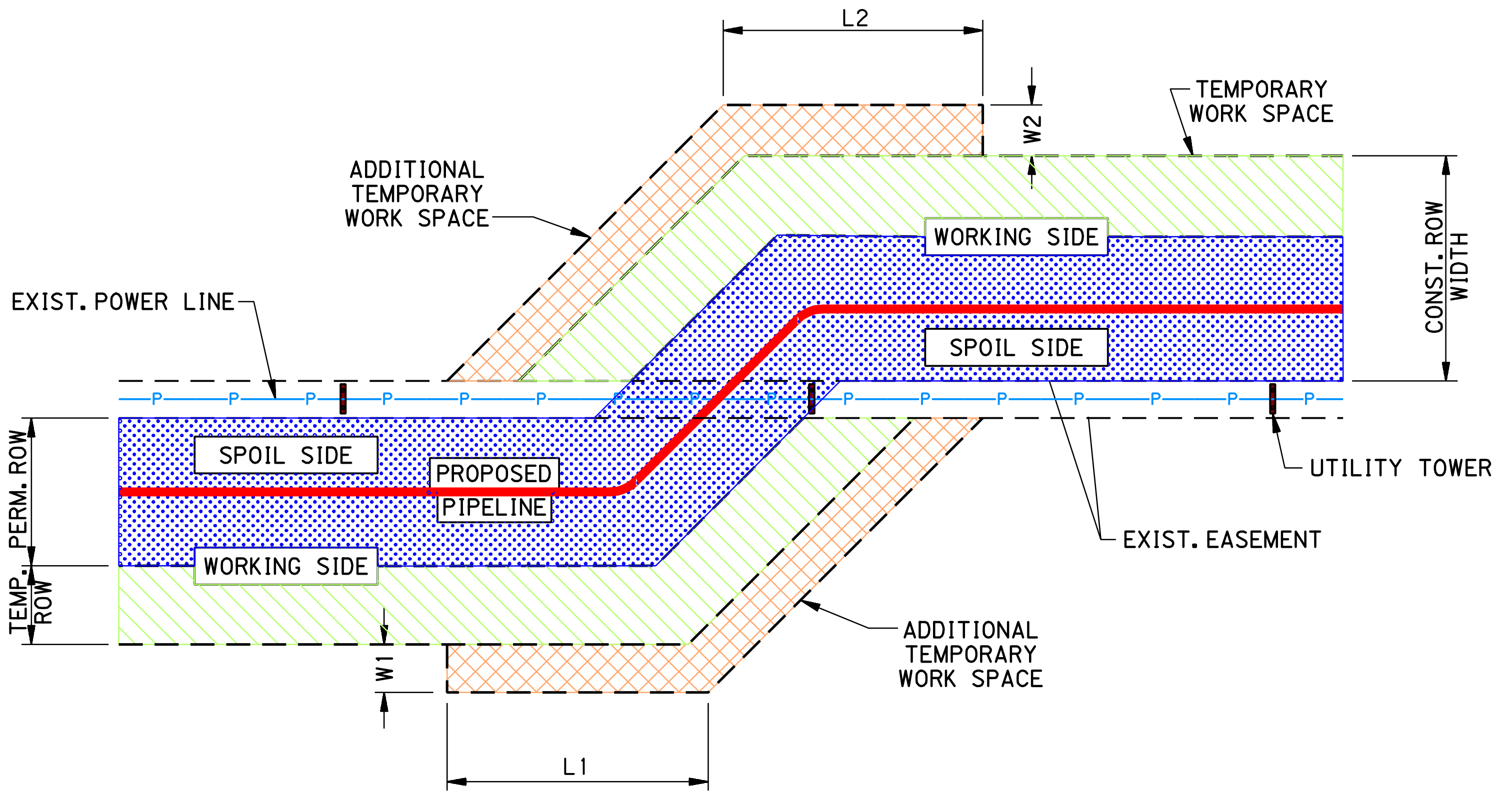
DRAWING NUMBER	SHEET
STD-INGAA-25	1 OF 1



NO.	REVISION	DATE	APPR.

The INGAA Foundation

MAINLINE CONSTRUCTION
POWER LINE CROSSOVER
RIGHT-OF-WAY

WILLBROS ENGINEERING/EPC
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(918) 496–0400

DRAWING NUMBER	SHEET
STD-INGAA-26	1 OF 1

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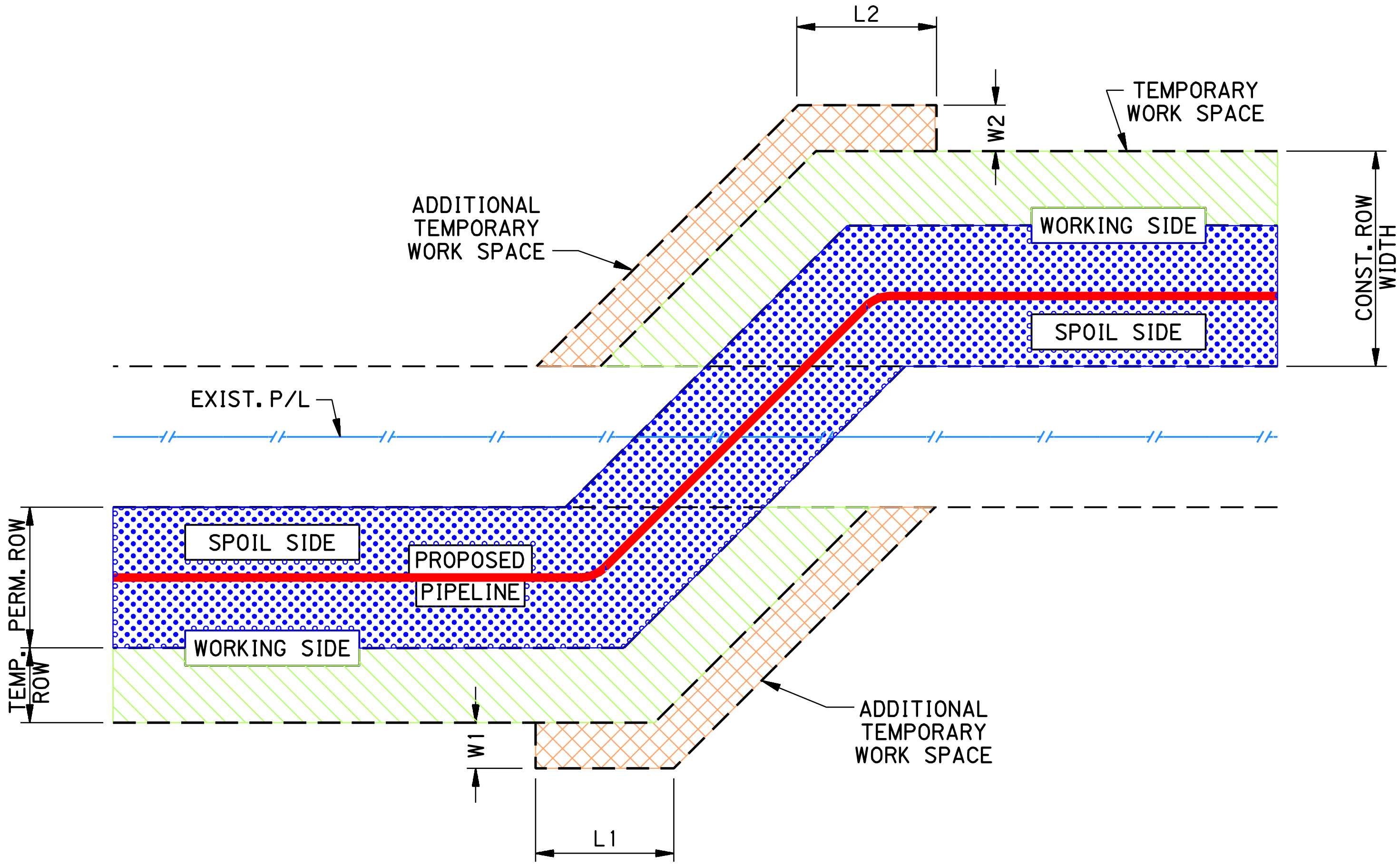

GENERAL NOTES:

1.) IF ATWS IS EXTENDED ONTO EXISTING R.O.W. OR WHERE EQUIPMENT IS TO CROSS, MATTING MAY BE REQUIRED.

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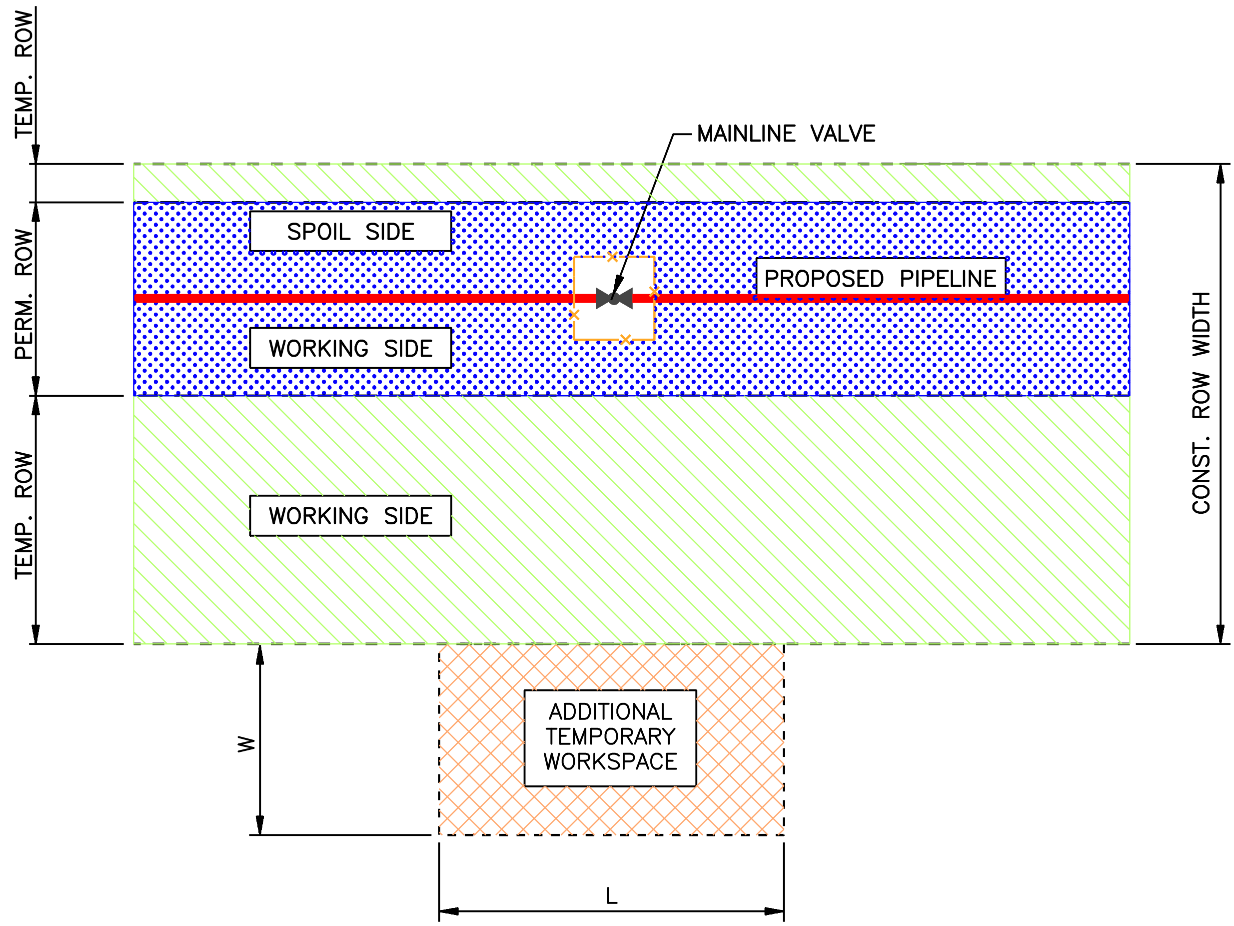
The INGAA Foundation

MAINLINE CONSTRUCTION PIPELINE CROSSOVER RIGHT-OF-WAY

DRAWING NUMBER	SHEET
STD-INGAA-27	1 OF 1



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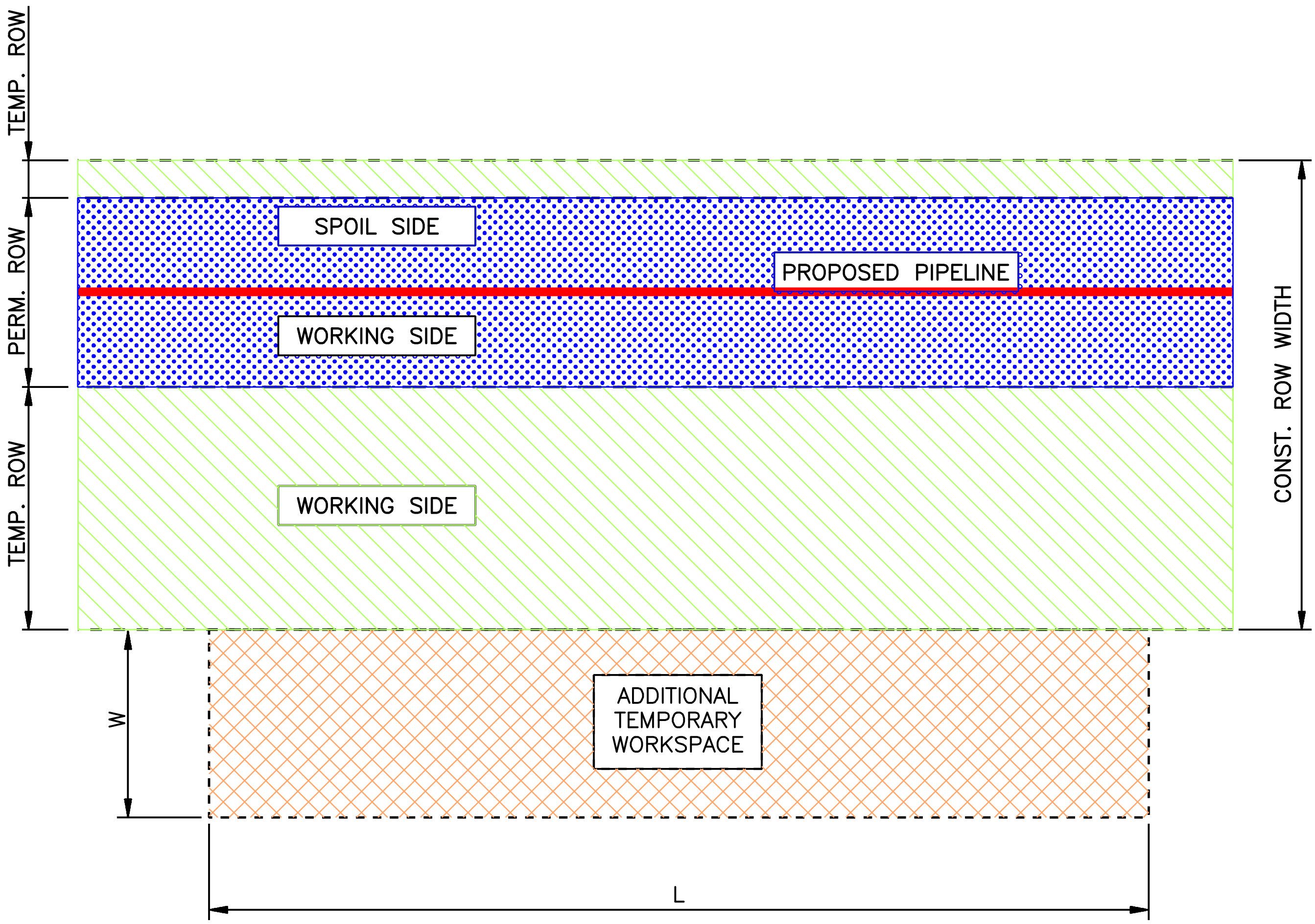
(918) 496-0400

The INGAA Foundation

MAINLINE CONSTRUCTION
MAINLINE VALVE SETTING
RIGHT-OF-WAY

DRAWING NUMBER	SHEET
STD-INGAA-28	1 OF 1



R.O.W. DIMENSIONS (FEET EXCEPT FOR DIAMETER, WHICH IS INCHES)		
DIAMETER PIPE	L	W
12"	125	25
16"	125	25
24"	175	25
30"	175	25
36"	250	50
42"	250	50
48"	250	50

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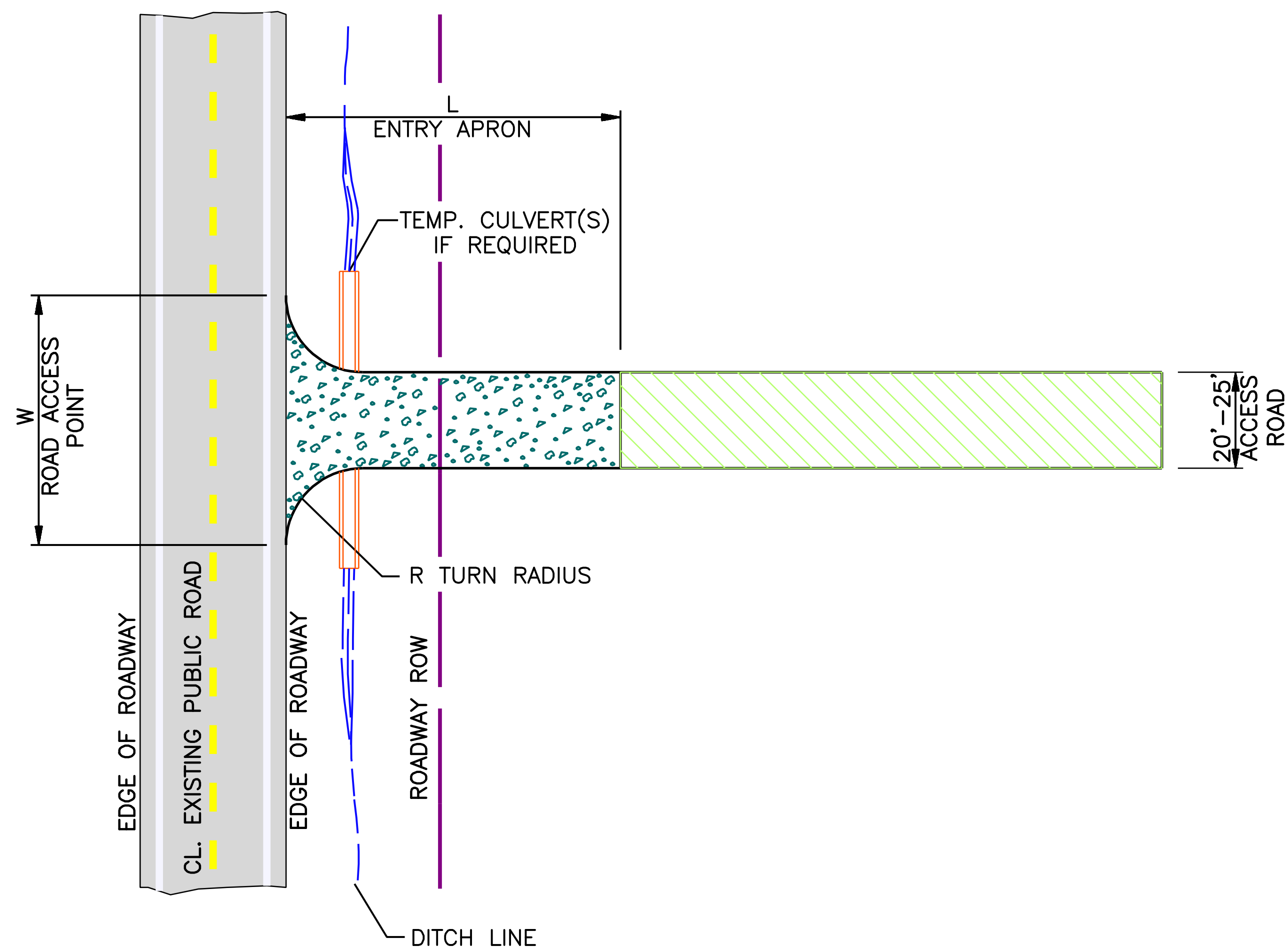
MAINLINE CONSTRUCTION
SPREAD BREAKS
START OR END
OR TURNAROUNDS

WILLBROS ENGINEERING/EPC
2087 E. 71st Street – Tulsa, OK 74136
(918) 496–0400

DRAWING NUMBER	SHEET
STD-INGAA-29	1 OF 1



GENERAL NOTES:

1.) DIMENSIONS FOR L, R AND W ARE AS REQUIRED BY LOCAL PERMITS.

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The INGAA Foundation

MAINLINE CONSTRUCTION
TYPICAL ACCESS ROAD
RIGHT-OF-WAY

DRAWING NUMBER	SHEET
STD-INGAA-30	1 OF 1

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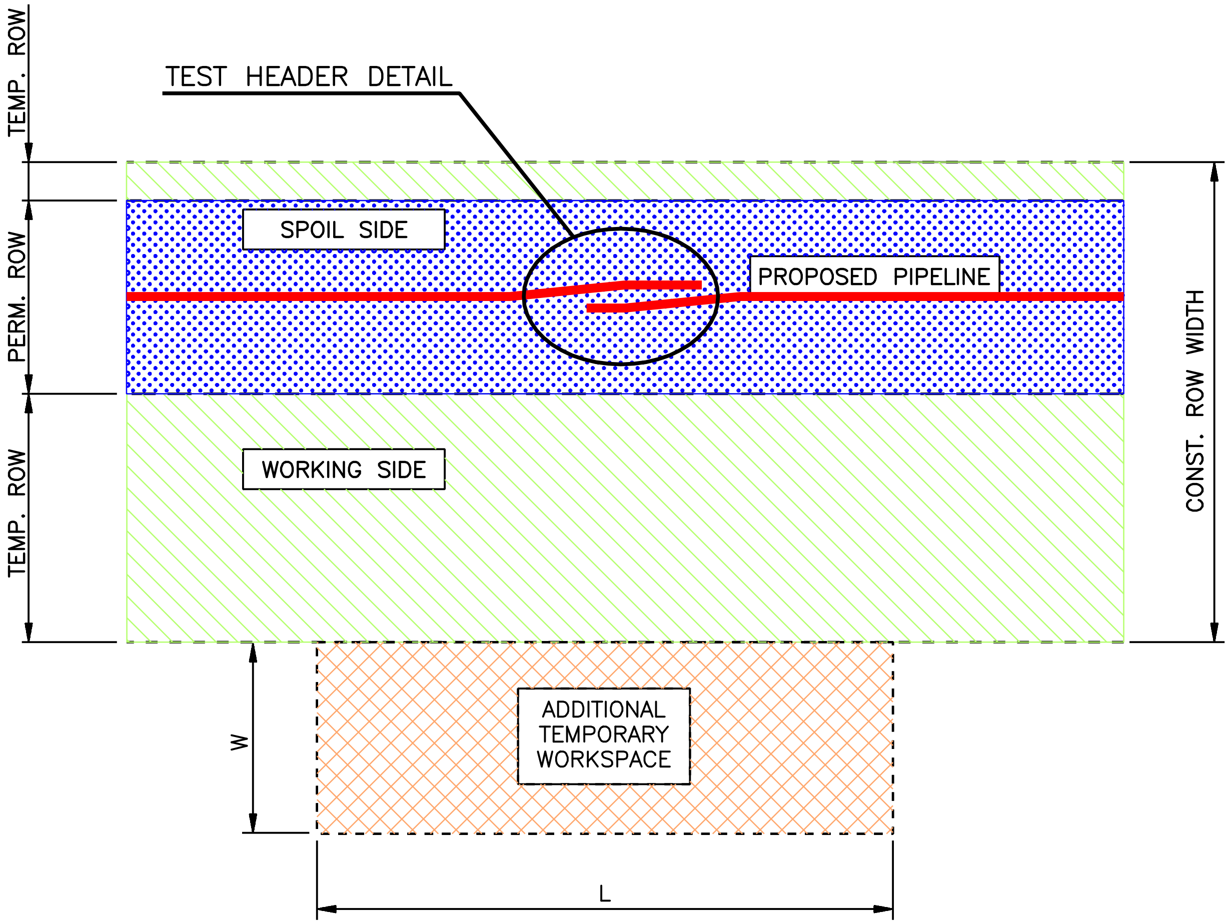

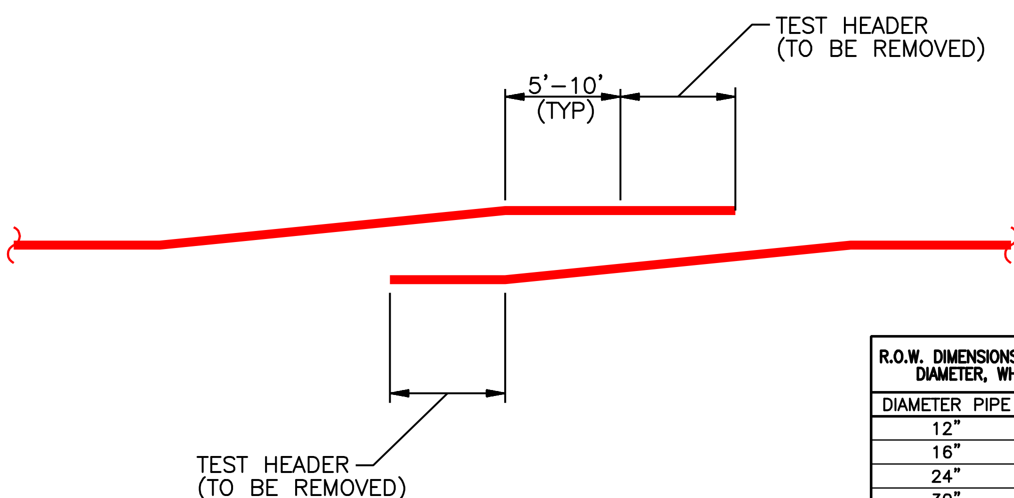

TEST HEADER DETAIL

R.O.W. DIMENSIONS (FEET EXCEPT FOR DIAMETER, WHICH IS INCHES)		
DIAMETER PIPE	L	W
12"	125	25
16"	125	25
24"	175	25
30"	175	25
36"	250	50
42"	250	50
48"	250	50

GENERAL NOTES:

1.) ATWS MAY BE REQUIRED ON SPOIL SIDE DEPENDING ON LOCAL SITE CONDITIONS.

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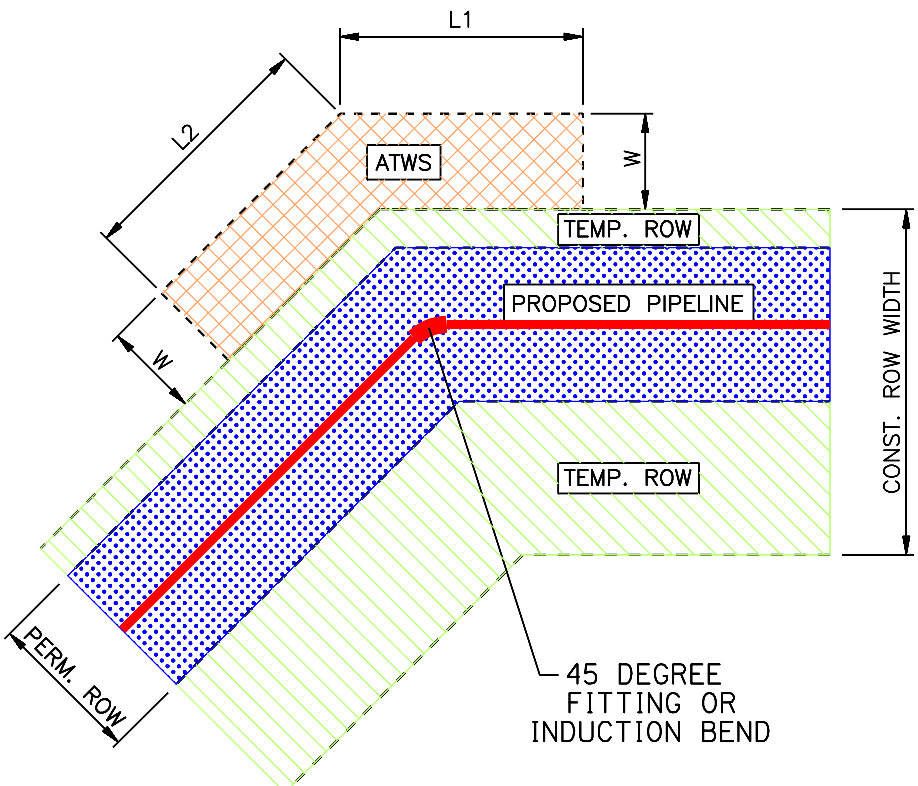
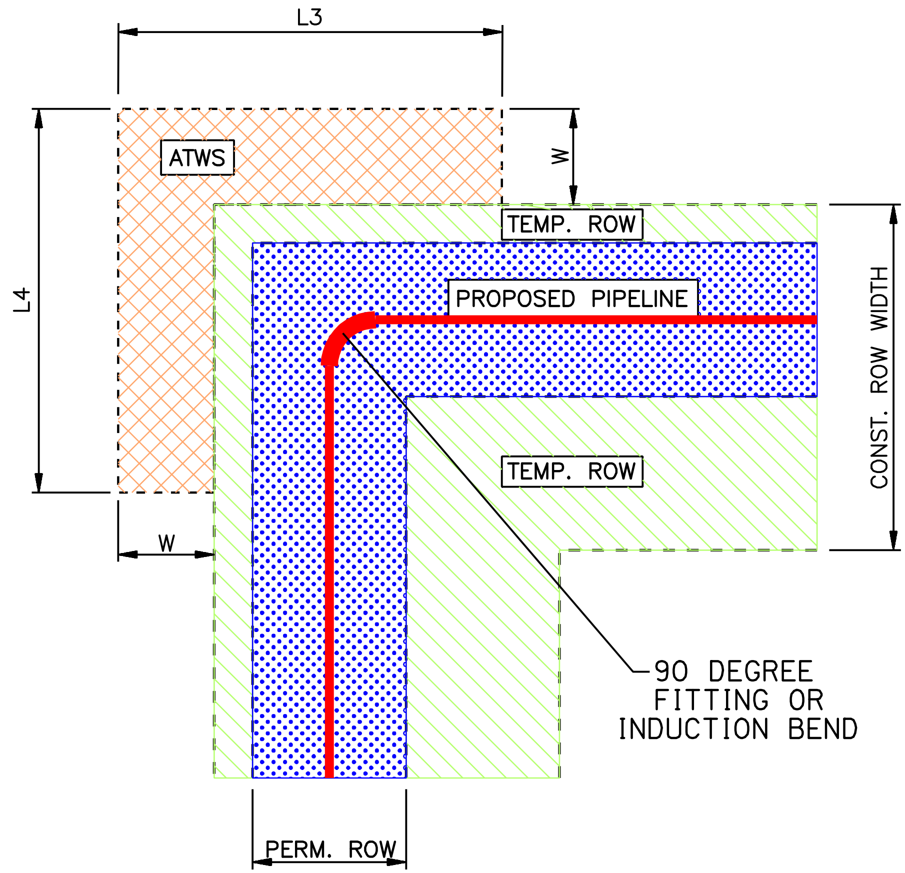
The INGAA Foundation

MAINLINE CONSTRUCTION
HYDROTEST STAGING AREA
RIGHT-OF-WAY

DRAWING NUMBER	SHEET
STD-INGAA-31	1 OF 1





NO.	REVISION	DATE	APPR.

The INGAA Foundation

MAINLINE CONSTRUCTION
FITTING OR INDUCTION BENDS
RIGHT-OF-WAY

WILLBROS ENGINEERING/EPC
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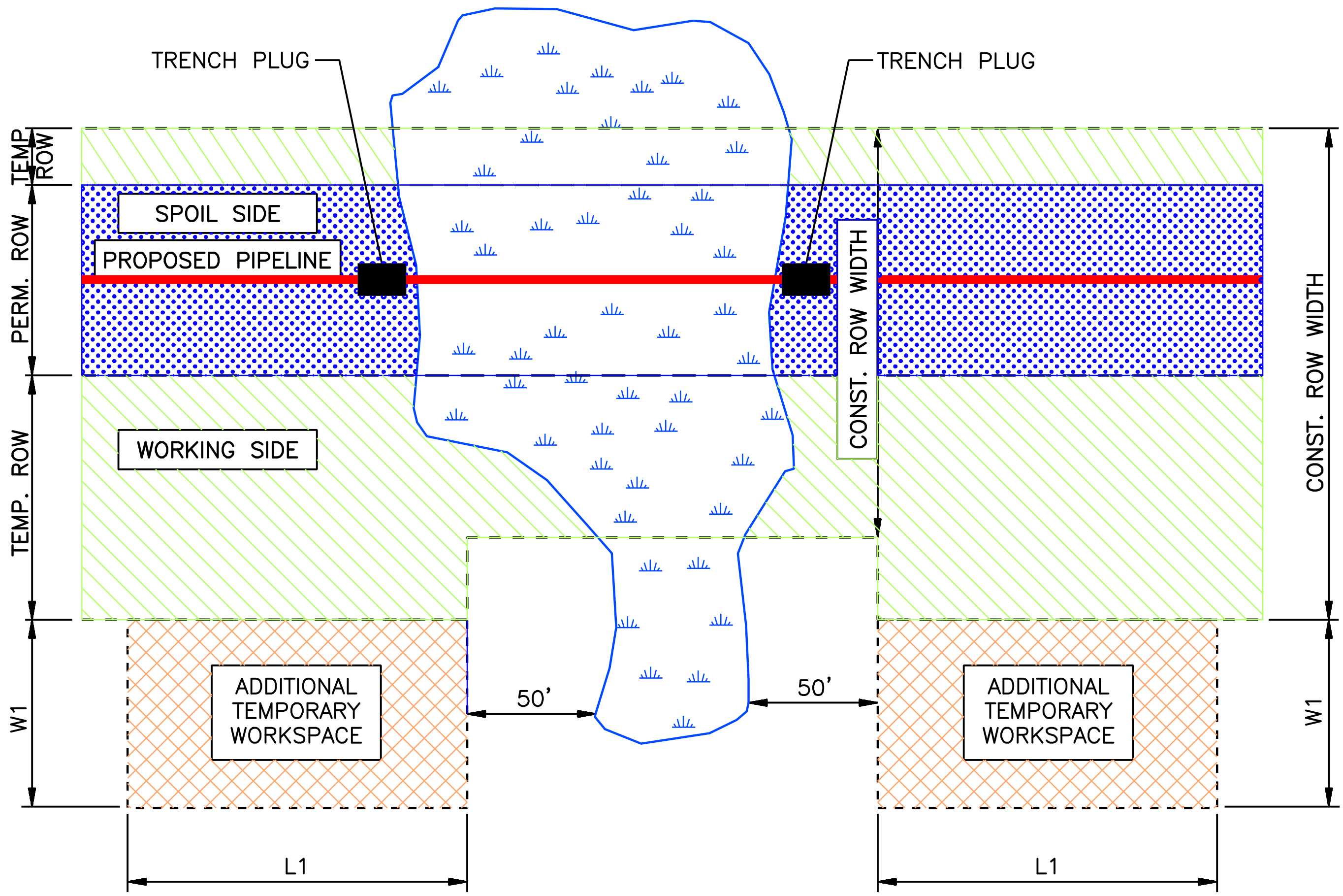
(918) 496-0400

DRAWING NUMBER	SHEET
STD-INGAA-32	1 OF 1



NO.	REVISION	DATE	APPR.

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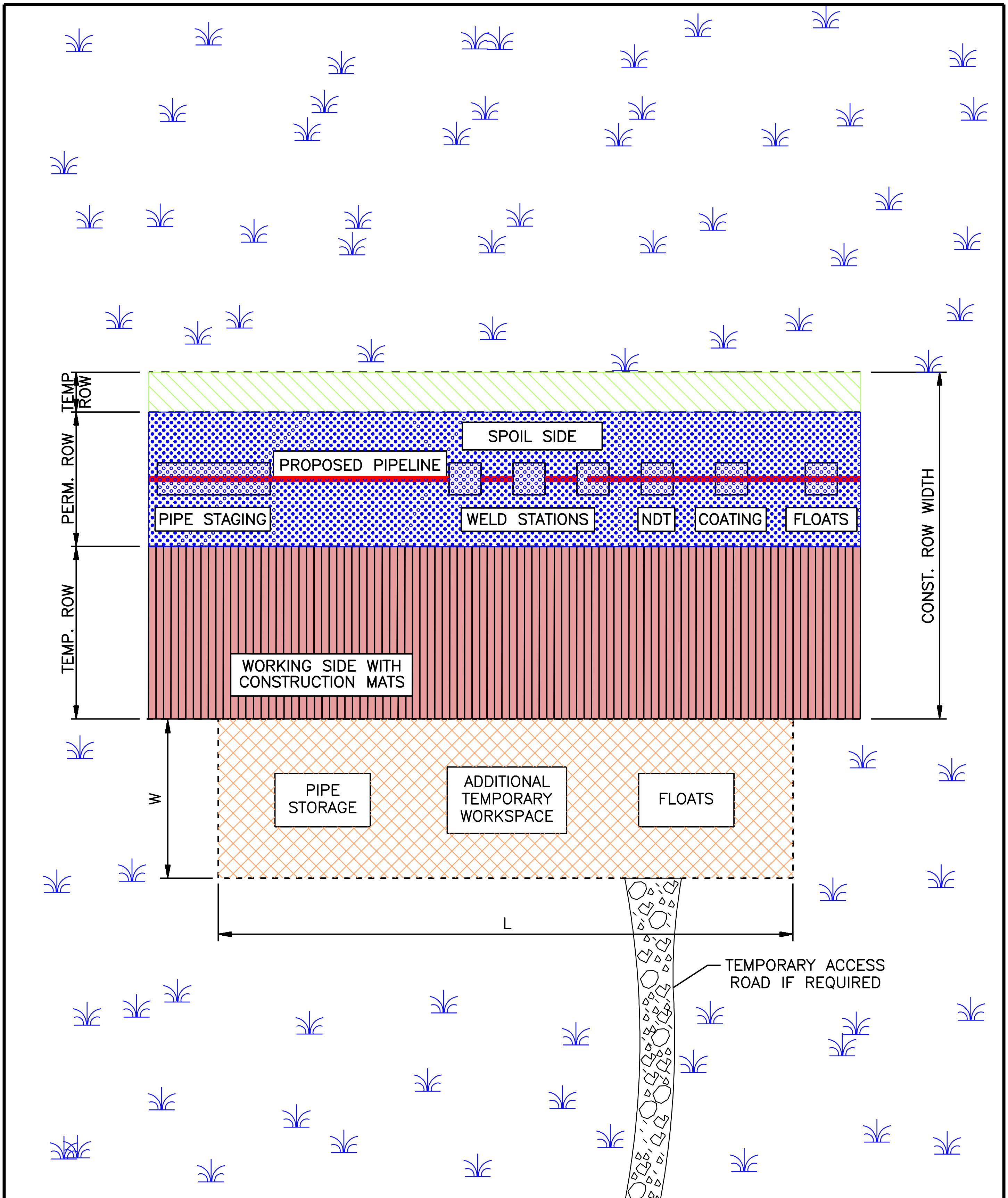
The INGAA Foundation

MAINLINE CONSTRUCTION
WETLAND CROSSING
RIGHT-OF-WAY

DRAWING NUMBER	SHEET
STD-INGAA-33	1 OF 1



GENERAL NOTES:

1.) L: 200' TO 400'
W: 200' TO 350'

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The INGAA Foundation

MAINLINE CONSTRUCTION WETLAND REQUIRING PUSH SECTION STAGING AREA RIGHT-OF-WAY

DRAWING NUMBER	SHEET
STD-INGAA-34	1 OF 1

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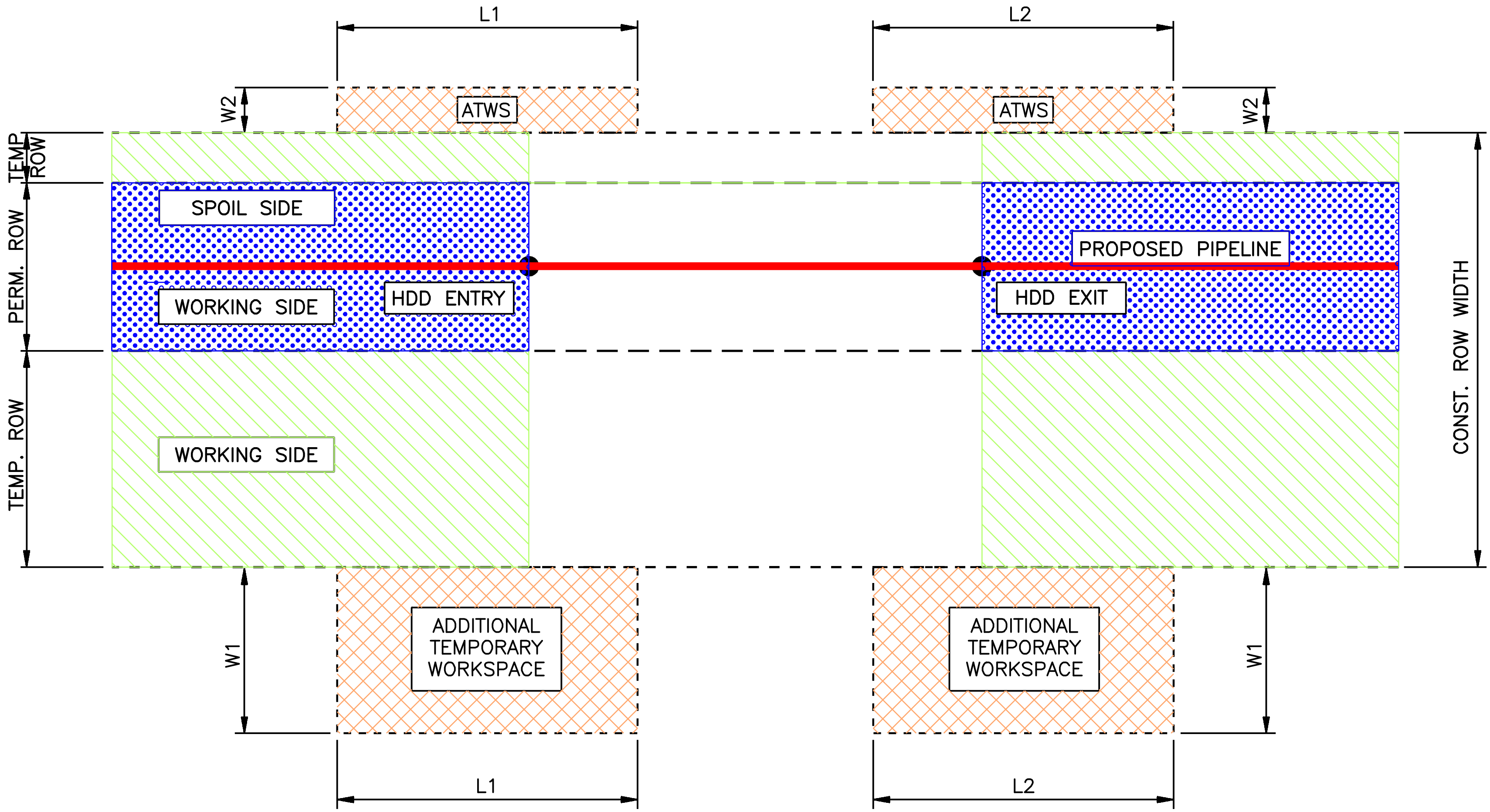

NO.	REVISION	DATE	APPR.

The INGAA Foundation

MAINLINE CONSTRUCTION
HDD TYPICAL
RIGHT-OF-WAY

DRAWING NUMBER	SHEET
STD-INGAA-35	1 OF 1

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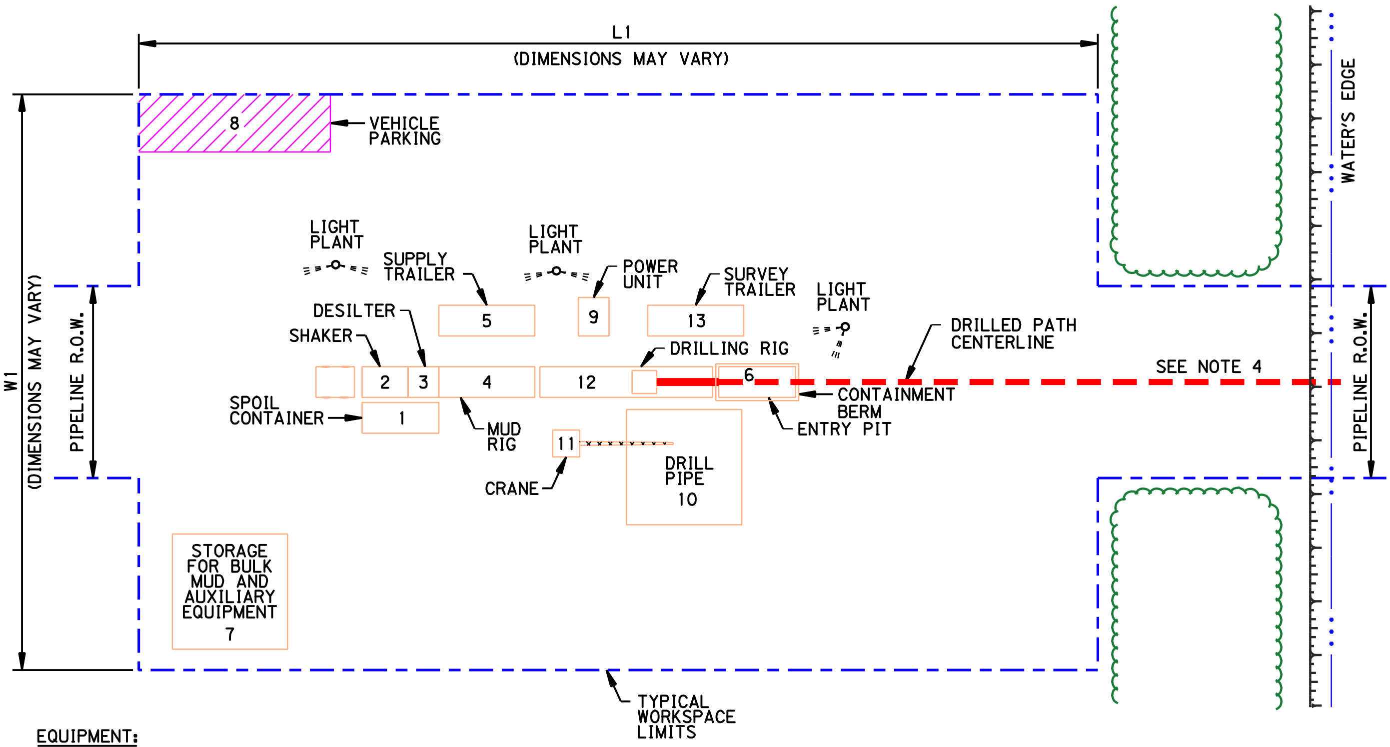


EQUIPMENT:

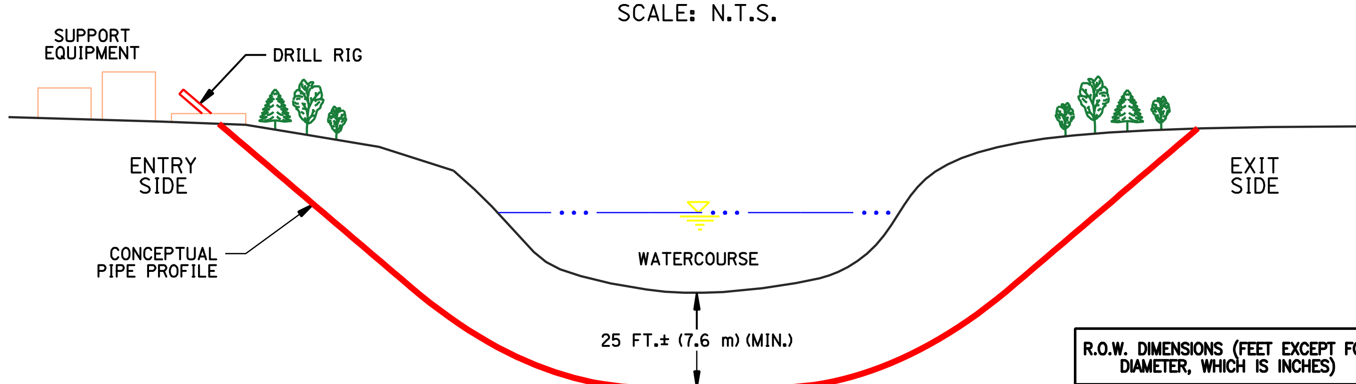
1. SPOIL CONTAINER: 8′ x 20′
2. SHAKER: 8′ x 12′
3. DESILTER: 8′ x 8′
4. MUD RIG: 8′ x 25′
5. SUPPLY TRAILER: 8′ x 25′
6. ENTRY PIT: 8′ x 20′
7. STORAGE: 30′ x 30′
8. VEHICLE PARKING: 15′ x 50′
9. POWER UNIT: 8′ x 10′
10. DRILL PIPE: 30′ x 30′
11. CRANE: 8′ x 8′
12. DRILLING RIG: 8′ x 45′
13. SURVEY TRAILER: 8′ x 25′

NOTES:

1. EQUIPMENT ORIENTATION MAY VARY DEPENDING ON CONTRACTOR OR SITE CONDITIONS.
2. EQUIPMENT TO BE SUPPORTED ON THE GROUND SURFACE OR TIMBER MATS AS CONDITIONS DICTATE.
3. SILT FENCE, BERMS AND/OR STRAW BALE BARRIER TO BE USED AS REQUIRED TO PREVENT IMPACTS FROM OCCURRING OUTSIDE OF PROJECT LIMITS.
4. HAND CLEARED ACCESS PATH WILL BE USED TO OBTAIN WATER FROM SOURCE WHERE PERMITTED.

ENTRY SITE PLAN

SCALE: N.T.S.



R.O.W. DIMENSIONS (FEET EXCEPT FOR DIAMETER, WHICH IS INCHES)		
DIAMETER PIPE	L1	W1
12"	150	100
16"	175	125
24"	225	150
30"	300	200
36"	300	200
42"	375	250
48"	450	300

PROFILE

SCALE: N.T.S.

GENERAL NOTES:

1.) PIPE DEPTHS MAY VARY.

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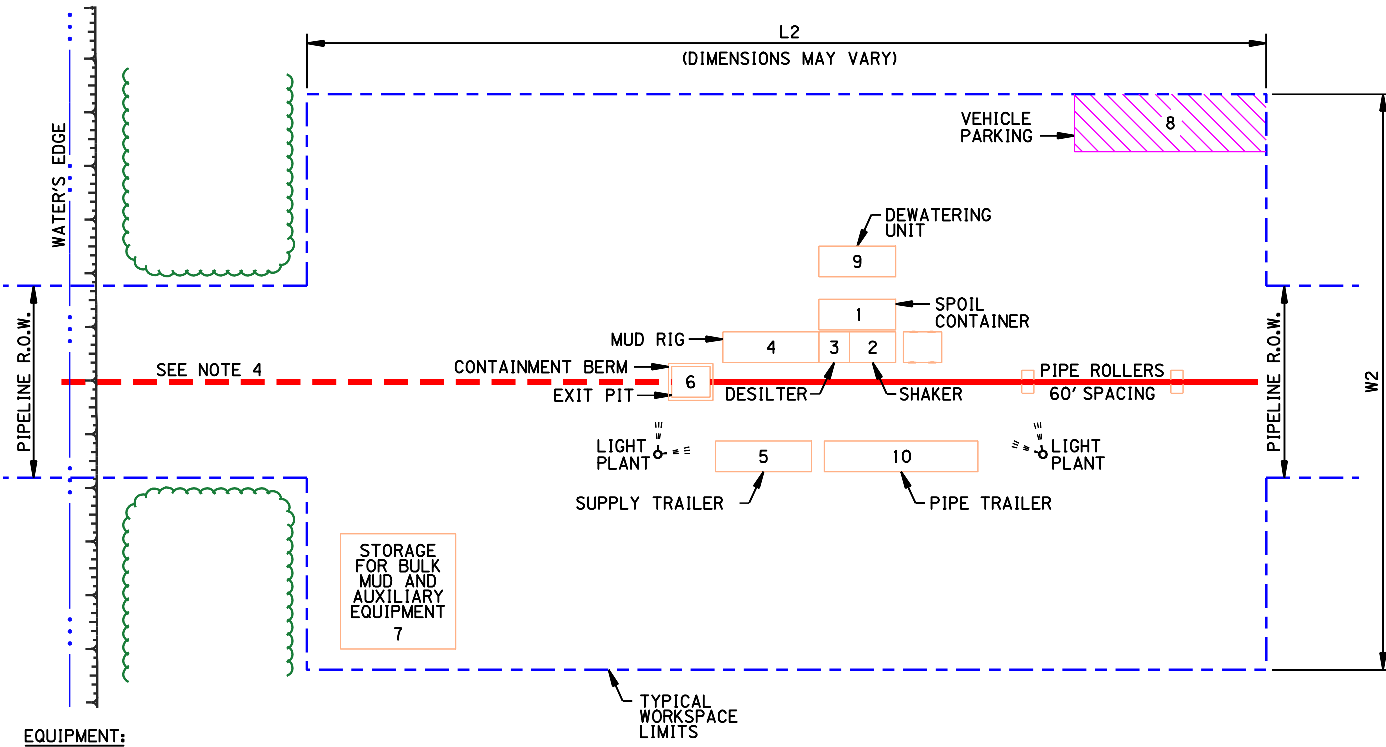
The INGAA Foundation

MAINLINE CONSTRUCTION
TYPICAL DIRECTIONAL DRILL
ENTRY SITE PLAN & PROFILE

DRAWING NUMBER	SHEET
STD-INGAA-36	1 OF 1



EQUIPMENT:

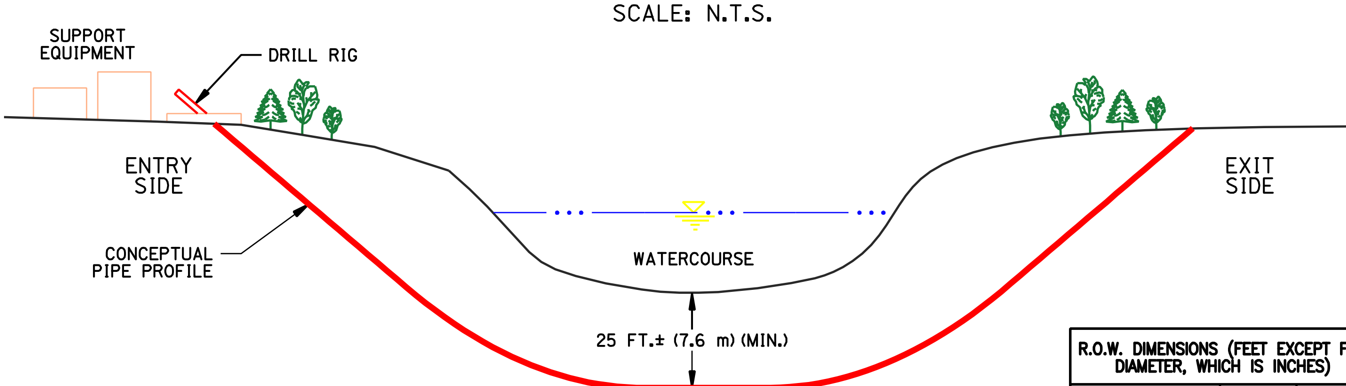
1. SPOIL CONTAINER: 8' x 20'
2. SHAKER: 8' x 12'
3. DESILTER: 8' x 8'
4. MUD RIG: 8' x 25'
5. SUPPLY TRAILER: 8' x 25'
6. EXIT PIT: 8' x 10'
7. STORAGE: 30' x 30'
8. VEHICLE PARKING: 15' x 50'
9. DEWATERING UNIT: 8' x 20'
10. PIPE TRAILER: 8' x 40'

NOTES:

1. EQUIPMENT ORIENTATION MAY VARY DEPENDING ON CONTRACTOR OR SITE CONDITIONS.
2. EQUIPMENT TO BE SUPPORTED ON THE GROUND SURFACE OR TIMBER MATS AS CONDITIONS DICTATE.
3. SILT FENCE, BERMS AND/OR STRAW BALE BARRIER TO BE USED AS REQUIRED TO PREVENT IMPACTS FROM OCCURRING OUTSIDE OF PROJECT LIMITS.
4. HAND CLEARED ACCESS PATH WILL BE USED TO OBTAIN WATER FROM SOURCE WHERE PERMITTED.

EXIT SITE PLAN

SCALE: N.T.S.



R.O.W. DIMENSIONS (FEET EXCEPT FOR DIAMETER, WHICH IS INCHES)		
DIAMETER PIPE	L2	W2
12"	150	100
16"	175	125
24"	225	150
30"	300	200
36"	300	200
42"	375	250
48"	450	300

PROFILE

SCALE: N.T.S.

GENERAL NOTES:

1.) PIPE DEPTHS MAY VARY.

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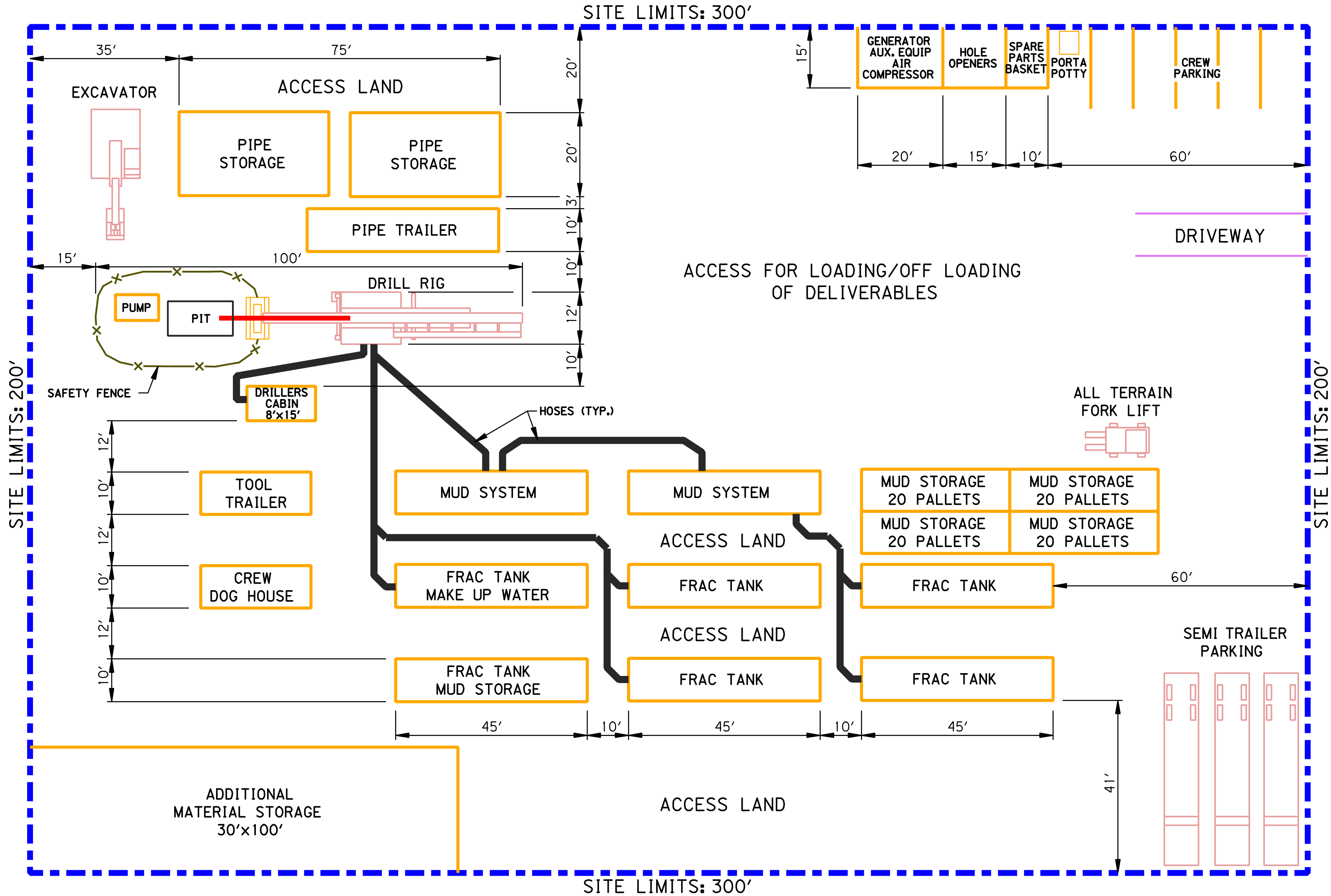
The INGAA Foundation

MAINLINE CONSTRUCTION TYPICAL DIRECTIONAL DRILL EXIT SITE PLAN & PROFILE

DRAWING NUMBER	SHEET
STD-INGAA-37	1 OF 1



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The INGAA Foundation

MAINLINE CONSTRUCTION
HORIZONTAL DIRECTIONAL DRILL
BIG RIG LAYOUT
200' x 300 SITE

DRAWING NUMBER	SHEET
STD-INGAA-38	1 OF 1

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GUIDELINES FOR PARALLEL CONSTRUCTION OF PIPELINES

Technical support to The INGAA Foundation, Inc. by:

Process Performance Improvement Consultants
1200 Post Oak Road, Suite 2705
Houston, TX 77056
USA

F-2008-05
December 2008 Version 1

INGAA Foundation Ad-Hoc Construction Committee

Steering Committee:

El Paso	Dan Martin, Chair
INGAA Foundation	Rich Hoffmann
Willbros	John Allcorn
Willbros	Curt Simkin
Alliance	Harold Kraft
Williams	Mario DiCocco
Mears	John Fluharty
CenterPoint Energy	Debbie Ristig
Kinder Morgan	Dwayne Burton
Sheehan Pipe Line Construction	David Sheehan

Parallel Construction Guidelines Development Work Group:

Alliance Pipeline	Harold Kraft
INGAA Foundation	Rich Hoffmann
Mears	John Fluharty
Transcanada	Mark Domke
Williams	Mario DiCocco
Williams	Tim Powell
El Paso	Mike Morgan
El Paso	Pat Carey
Bi-Con Services	Denny Patterson
CenterPoint Energy	Erik Dilts
Transcanada	Tracy Schultz
Transcanada	Phillip Bohannon
Transcanada	Rob Reed
Willbros	Tom Alexander
Kinder Morgan	Kirk Steinberger
Price Gregory	Mike Langston
Helmer Risk Management	Scott Helmer
Process Performance Improvement Consultants, LLC	Mark Hereth, Technical Support and Facilitation

INGAA Foundation
Guidelines For
Parallel Construction of Pipelines
December 2008
Version 1

I. Introduction

We are in a period of increased pipeline construction activity that is expected to continue through 2011, and possibly beyond. The Federal Energy Regulatory Commission (FERC) and other Federal agencies are encouraging and sometimes requiring interstate natural gas pipeline operators to use existing rights-of-way (ROW), where possible, when proposing routes for new construction[1]. This is occurring throughout the country, even in more rural, sparsely populated areas[2]. Recently, there have been a series of incidents where existing pipelines have been damaged during **parallel construction**.

Foundation members have elected to address the challenges of this increased construction and the current regulatory environment by providing guidance to designers, constructors, operators and regulators to prevent personal injury or property damage to either the existing or new pipeline when new construction is undertaken parallel to existing facilities. Workshops were held in July and November 2007 to identify the means to address the concerns that arise during parallel construction, and again in April and June 2008, to define a path forward in developing guidelines for parallel construction.

The guidelines primarily focus on precluding unsafe conditions and reducing the occurrence of incidents of damage or personal injury during parallel construction adjacent to existing energy pipelines. The members recognize this approach can be applied to other linear facilities. The members believe, however, that expanding this effort to other facilities, such as electric transmission, sewer and water facilities, and telecommunication requires a more long-term initiative.

These guidelines were developed using a consensus process by a work group formed by Foundation members. The guidelines draw upon the experience and leading practices of the full breadth of INGAA Foundation members as well as practices used throughout the industry, including the Common Ground Alliance (CGA) Best Practices and API 1166 – Recommended Practice on Excavation Monitoring and Observation. The measures proposed in this document tie to those used as a standard practice in FERC proceedings and

[1] Federal Energy Regulatory Commission regulations (18 CFR §380.15[d][1]) pertaining to pipeline siting and maintenance requirements state that use, widening, or extension of existing rights-of-way must be considered in locating proposed facilities.

[2] The Energy Policy Act of 2005, Section 368, stipulates the need for construction of pipelines in common corridors, the most extensive of which is the West-Wide Corridor Study. This exhaustive study, now undergoing final review, before being issued, will amend federal land use plans across the West.

industry recommended practices. They constitute minimum measures and nothing prevents the parties from agreeing to additional or more stringent measures.

Whether or not construction is considered to be "parallel" is established by the beginning and ending of the **Encroachment Area**. The work group considered and ultimately rejected specifying a paralleling length threshold under which these guidelines will apply. The group arrived at a consensus that application of these guidelines was appropriate regardless of the length the existing and new facilities are in parallel.

While the primary emphasis of these guidelines is on the interaction between existing pipeline operators and those operators planning to construct in a parallel fashion, it is expected that contractors working on behalf of the pipeline operators, including environmental and survey professionals, design engineers, construction contractors, and operators of excavation and earth moving equipment will engage in work practices that are in conformance with these guidelines, and apply vigilance in identifying unanticipated circumstances that may indicate a problem. It is encouraged that these guidelines be referred to in contract documents executed with contractors and subcontractors.

II. Definitions

A. Parallel Construction is construction of new facilities in close proximity to existing facilities. The extent of Parallel Construction is established by the beginning and ending of the Encroachment Area. Application of the guidelines is appropriate regardless of the length the existing and new facilities are in parallel.

B. Encroachment Area is the area where the limits of disturbance are within 50 feet of the centerline of the existing facility, or within the existing facility's right-of-way (ROW) or other easement, whichever is greater. Additional distance may be required for other considerations, such as topography, side-hill lays, cathodic protection, environmental or engineering conditions, size of pipe and operating equipment, and topography.

C. Active Excavation Area is an area where the edge of the disturbance is within 25 feet of the centerline of existing facilities, unless on the ground situations stipulate additional clearance above ground as well as underground.

D. Excavation Tolerance Zone is an area within two feet (24 inches) of the existing facilities, or the distance mandated by state law where applicable, whichever is greater. (More conservative than CGA Practice 5-19 that stipulates 18 inches.)

E. Existing Facility Representative is the person designated by the existing facility's operator to inspect when excavation equipment is operating in the Active Excavation Area. (Consistent with CGA, Excavation Practices, Practice 5-18.)

F. Designated Contact is the single point of contact identified within the existing facility and new pipeline company.

G. Due Diligence Corridor is equal to the width of the proposed survey corridor plus 50 feet on each side. The survey corridor is the corridor width typically used for biological surveys, for example.

III. Guidelines for Consideration:

A. In General

INGAA Foundation Members engaged in parallel pipeline construction including operators of existing pipelines, the new pipeline, designers, constructors, surveyors, locators, environmental professionals, excavators and consultants will embrace the following:

"Damage prevention is a shared responsibility. Whether you are a facility owner/operator, locator, design professional, one-call center employee, excavator/contractor or other stakeholder, ensuring safety of those who work or live in the vicinity of underground facilities and protecting our vital services is everyone's responsibility." (Common Ground Alliance Best Practices, Version 5.0, Inside Cover Page, March 2008)

B. Preconstruction

1. As part of initial route selection, the new pipeline operator will perform due diligence to identify existing underground and adjacent aboveground structures and determine the service (pipeline [oil or gas], electric power line, sewer, water, telecommunication, or cable), size (diameter), materials of construction (steel, plastic, etc.), status of service (active or abandoned), pressure (or voltage) in a **Due Diligence Corridor**. The **Due Diligence Corridor** can be adjusted with respect to the centerline, based on the existence of wetlands, vegetative cover, topography, geology, pipe diameter, and required work area, among other factors.

The new pipeline operator will contact the operator of the existing facility and arrange for a Planning and Design review meeting. The respective organizations will establish single points of contact (referred to as **"Designated Contacts**"). The intent of the Planning and Design review meeting is for the parties to exchange key information about their existing and proposed new facilities, to work through and agree upon respective work processes and procedures, to establish clear lines of communication, and to discuss any other details needed to assure that the new facility may be constructed safely and efficiently, while simultaneously protecting the existing facility from damage. The meeting will address items such as placement of ROW; location in ROW; types of easements (exclusive, or open and undefined); construction methods and practices; unique landscape, terrain, or environmental situations; separation distances; and ground disturbance timing. The contact should be initiated no later than the filing of the request to begin the Pre-filing Process at FERC, or as early in the routing process as possible. (Refer to Planning and Design Review Meeting Agenda – Attachment A).

2. It is the new pipeline operator's responsibility to gain access for the purpose of conducting a survey. Subsurface Utility Engineering (SUE)[3] Quality Level C will be used for those facilities nearby, that is, making use of records tied to aboveground facilities and indirect locating as needed.

3. For new pipelines within the **Encroachment Area**, the new pipeline operator will enter into an agreement with the existing facility operator in the form of an encroachment agreement, if requested by the existing facility operator. The new pipeline operator will incorporate the relevant terms of the encroachment agreement into all supporting prime and sub- contract agreements.

4. The encroachment agreement will specifically address cathodic protection facilities. Coordination between parties will include the existing and new cathodic protection systems, location of concentrated ground beds, distributed anodes, test stations, potential interference, etc.

5. The new pipeline operator will identify areas where blasting will be used along the route within 300 feet of the existing facilities. A blasting plan must be developed and agreed to by both parties.

6. In preparation of conducting a corridor survey, the new pipeline operator will contact the existing facility operator or use the one-call system where a design ticket is available. The one-call request will include specific starting and ending points using GPS coordinates to ensure that any **Encroachment Areas** are included.

7. In addition to state requirements for one-call center notification, the existing facility **Designated Contact** will notify the new pipeline **Designated Contact** that there is no conflict or that the line will be marked (referred to as "positive response"[4]. (Consistent with CGA, Locating and Marking, Practice 4-9.)

8. The existing facility operator will, or by delegation, cause[5] its facilities to be located and marked using appropriate line location methods that will assure the accurate placement of the markers.

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[3] - ASCE 38-02, Standard Guideline for the Collection and Depiction of Existing Subsurface Utility Data, 2002.

[4] - A one-call request at this stage results in a design ticket in some states. In some states this requires only an exchange of information. It is the intent of this agreement that existing lines be marked if they are within the Due Diligence Corridor.

[5] - The phrase, "will or cause" is used to indicate that the existing operator may elect to locate and mark the line, or through agreement allow the new pipeline or it's agent to locate and mark the line.

9. Markers will be placed in the **Due Diligence Corridor** at a maximum spacing not to exceed 200-foot intervals or line-of-sight, whichever is closer, and all points of inflection (“PIs”).

10. The new pipeline operator will regularly communicate and coordinate with the operators of the existing facilities concerning the status of the project for the duration of the project. (Consistent with CGA, Planning and Design, Practice 2-4.)

C. <u>Construction</u>

1. The new pipeline operator will contact the existing facility operator at least 30 days prior to initial ground disturbance.

2. The new pipeline operator will provide the existing facility operator with a proposed schedule for construction. The new pipeline operator will provide weekly updates during the construction process until such time that the new pipeline’s activities are no longer in the **Encroachment Area**. The end of the process will be specified as the completion of final restoration and any associated follow-up.

3. The new pipeline operator will use the one-call system in advance of beginning ground disturbing activity.

4. The existing facility operator will, or by delegation, cause its facilities to have marks adjusted to a maximum spacing not exceeding 50-feet, including all PIs. This can be adjusted at the discretion and agreement of both parties. Existing facilities will be continuously located, marked and there will be positive identification at PIs. The marks will be maintained for the duration of work planned in the **Encroachment Area**.

5. In general, the existing facility operator has the option to have an inspector on site during any ground disturbance in the active excavation area even if the activities follow the plans established in the Design Review and subsequent meetings. The existing facility operator will have an inspector on site during any ground disturbance when changes in prior plans within the **Active Excavation Area** have not been evaluated by the existing operator. (Consistent with API 1166).

6. The new pipeline operator will notify the existing facility operator’s **Designated Contact** to provide ample time to respond. Notification will take place no less than 24 hours prior to beginning ground disturbance in an Active **Excavation Area**. There may be circumstances where a spread crew may want to move to an area for which notification has not been provided. Excavation will not commence until the existing pipeline operator has been notified and agrees to provide an observer or authorizes the new pipeline operator in writing to commence with work.

7. The new pipeline operator will ensure that only agreed to techniques are used within the **Excavation Tolerance Zone** and for excavations that may expose the existing facility.

8. The existing facility's representative has the authority to stop work at any time he/she believes the safety of personnel or existing facilities are endangered.

9. The new pipeline operator will ensure that excavation equipment with teeth, such as on a backhoe bucket, will be barred and side cutters removed when working in an **Active Excavation Area**, except where a site specific plan has been approved by the existing facility.

10. The new pipeline operator or pipeline constructor will not excavate unless they have visual confirmation of the existing pipeline's location. This means that no excavation will be conducted within the **Active Excavation Area** of an existing pipeline unless there are marks indicating the placement of the pipeline, (until such a point where the marks extend off the ROW indicating that the existing pipeline is no longer within the **Active Excavation Area**).

11. If the existing pipeline operator observes excavation equipment in an **Encroachment Area** and is unaware of planned activities, a contact card on a string, or other comparable method, will be placed on the door handle, or steering wheel, of the subject equipment. For example the card might state, "Natural gas facility in the vicinity, danger, call before you dig, Call 811".

12. The new pipeline operator will identify any new areas where blasting will be used along the route within 300 feet of the existing facilities.

13. The new pipeline operator will identify and propose plans for all crossings of the existing pipeline(s), and such plans will be agreed upon by both parties. Discrete crossings will be addressed in the encroachment agreement.

14. The new pipeline operator will be responsible for all damages, repairs and rehabilitation caused by its construction activities, as well as restoration of disturbed portions of the existing facility right-of-way, to the satisfaction of all parties, including the existing facility and any authorizing agencies.

D. <u>Post Construction</u>

1. The new pipeline and existing facility operators will hold a post-construction review meeting to identify problems and issues, as well as define remedies or corrective actions. The new pipeline operator will document the meeting including a review of the effectiveness of the guidelines and areas of improvement. (Refer to Recommended Agenda – Post Construction Review and Lessons Learned– Attachment B).

2. The new pipeline and existing facility operators will jointly share any lessons learned in the process of project execution or in the post-construction project review through the INGAA Foundation, Executive Director.

3. As-built centerline survey data for the new pipeline will be provided to the existing facility operator to assist them in identifying the location of the new pipeline during future maintenance and expansion activities.

Attachment A
Planning and Design Review Meeting(s) Agenda

Overview of Project
Identify **Designated Contact**
Identify parallel segment begin-end points – such as alignment drawings and GPS coordinates
Identify locations where working in close proximity – such as crossings
Availability and accuracy of as-built alignment documentation
Location of existing and proposed appurtenances
Anticipated route
Placement of ROW
Location in ROW (nominal and known exceptions)
Type of easement, exclusive, or open and undefined,
Separation
Anticipated crossings (including directional drills)
Construction methods and practices, including blasting
Identification of potential hazards and emergency response
Existing facility’s encroachment and crossing agreements
Existing facility’s policy on hand excavation or other excavation techniques around underground facilities
Schedule
Updating process

Attachment B
Post-Construction Review and Lessons Learned Agenda

What worked?
What didn't?
Did the guidelines make the project safer?
Did the guidelines make communication more effective?
What improvements or additions would you make to the process?